

**INVENTORY OF COAL GASIFICATION
PLANT WASTE SITES
IN ONTARIO**

VOLUME I

1525 Carling Avenue, Suite 600
Ottawa, Ontario, Canada K1Z 8R9
Telephone: (613) 728-6111
Telecopier: (613) 728-4009
Telex: 053-3935



**INVENTORY OF COAL GASIFICATION
PLANT WASTE SITES
IN ONTARIO**

VOLUME I

Prepared for
Ontario Ministry of the Environment
Waste Management Branch
40 St. Clair Avenue West
Toronto, Ontario

Prepared by
Intera Technologies Ltd.
Ottawa, Canada

FINAL REPORT

EXECUTIVE SUMMARY

This report describes the results of an inventory and preliminary assessment of potential environmental impacts of manufactured gas plant waste sites in the Province of Ontario.

This study was prompted by the recent discovery of buried wastes at sites which were at one time manufactured gas plants. Manufactured gas plants produced gas for illumination and heat in Ontario for over 100 years from about 1850 to the late 1950s mostly by carbonization of coal. In addition to combustible gas, these plants produced by-products, such as tars, sludges, liquors and other gas cleaning wastes. The chemical groups of primary concern are polynuclear aromatic hydrocarbons (PAH) and light aromatic hydrocarbons. Several compounds in these chemical groups that are contained in tars have been documented as cancer-causing. Adverse human health effects from exposure to these chemicals is primarily by inhalation and dermal contact.

A four phase approach was used to complete this study. The phases were: 1) a historical record search to identify former manufactured gas plant waste sites, 2) site reconnaissance visits to each site to determine land use and evidence of buried waste, 3) assessment of potential environmental impact and 4) development of options for further action at each site.

The historical record search identified 41 manufactured gas plants in 36 different communities in Ontario. The list of these gas plants, together with their street address and approximate years of operation are listed in the table accompanying this summary. The distribution of these former gas plant sites in Ontario is shown on Plate 1 in this report.

The listing describes "town gas" facilities that manufactured gas for municipal illumination and heating. Industrial facilities that utilized coal carbonization for manufacturing of gas, coke, ammonia and other products were not specifically addressed in this study, but an overview of these types of plants and others that generated, processed and handled tars and sludges containing PAH are provided in Section 5 of this report. Off-site disposal areas for gas plant wastes are also not included in the above listing as a result of a paucity of data. Where reported, off-site disposal areas are identified in Appendix B of this report on fact sheets for each plant site.

Site reconnaissance visits were made to all but one of the sites identified from the search of historical records. The primary purpose of the site reconnaissance visits was to identify any visual and olfactory evidence of buried wastes and any environmental impacts that may be related to the wastes. Because many of the former manufactured gas plant sites are located in developed areas, the site reconnaissance visits included inspection of sewers, basements and building sumps. Information collected from site inspection, from the record search and from municipalities were recorded on a fact sheet for each site.

Using data recorded on the fact sheets and a set of criteria developed specifically for former gas plant waste sites, a qualitative assessment of potential environmental impacts was performed for each site. The assessment criteria are based on characteristics of the site, evidence of buried wastes and characteristics of potentially impacted resources. Options for further actions at each site are developed based on the assessment of potential environmental impact.

As a minimum, options for further action at every site include notification of municipalities and current property owners that manufactured gas plant wastes in the form of tars and sludges that contain PAH are likely buried on-site. There is strong evidence from

excavation history at other sites to indicate that buried wastes likely exist at those manufactured gas plant sites for which little information is available on subsurface conditions. Consequently, any excavation at these sites, that may disturb the subsurface and therefore possibly breach underground waste contaminant structures should only be undertaken after review of historical maps and performance of exploratory soil borings and in consultation with Ontario Ministry of the Environment officials.

Based on available information, several of the sites identified in this study show potential for environmental impact, as a result of confirmed existence of tars and sludges on site that are currently or may impact off-site properties and water resources. These sites include in alphabetical order: Belleville, Guelph, Kitchener, London, Ottawa (King Edward Avenue), Ottaws (Lees Avenue), Peterborough, Port Stanley, St. Thomas, Toronto Station "A", and Waterloo. Other sites may be of concern, however based on available information it is not possible to confirm waste existence and potential environmental impact.

Site assessment studies, funded by the property owners, are currently underway or have been undertaken at the Barrie, Kitchener, Ottawa (King Edward Avenue), Ottaws (Lees Avenue), Peterborough, Port Stanley, part of Toronto Station "A", Waterloo and Woodstock sites.

List of Manufactured Gas Plant Sites in Ontario
1840-1970

COMMUNITY	ADDRESS	APPROXIMATE YEARS OF OPERATION
Barrie	17-31 Kempenfelt Dr. between Sampson St. and Duckworth St.	1878-1939
Belleville	110-118 Church St. between St. Paul and Dundas St. E.	1854-1947
Brampton	Northeast corner of Nelson St. and George St.	1888-1917
Brantford	East Ave. bounded by Alfred, Newport, East and Colborne Sts.	1860-1911
Brockville	40 St. Paul St. bounded by St. Paul and King Sts. and Butlers Creek	1853-1957
Cambridge (Galt)	140 North Water St. bounded by Grand River and opposite Simcoe St.	1887-1911
Chatham	307 King St. W. bounded by Second St., King St. W., Third St. and Thames River	1873-1929
Cobourg	Between Queen and Charles Sts. west of McGill St. and east of Division St.	1857-1937
Cornwall	S.W. corner Water St. E and Amelia St.	1882-1929
Deeronto	South side of Main Street between First - Second St.	1886-1920
Dundas	43 Cootes Dr. on E. side of Thorpe and King St. E.	1863-1909

COMMUNITY	ADDRESS	APPROXIMATE YEARS OF OPERATION
Guelph	118-124 Fountain St., N.W. corner of Fountain & Wyndham Sts.	1871-1957
Hamilton	1. N. and S. of Mulberry St. between Bay North & Park North St.	1850-1925
	2. Hamilton By-Product Coke Ovens, Burlington-Industrial Depew St. area	1924-1958
Ingersoll	83 Avonlea St, N. end of Avonlea St. at railway tracks	1876-1915
Kingston	Bounding blocks, Place D'Armes Ontario, Queen, and Barrack Sts.	1848-1957
Kitchener	Gaukel St. bounded by Joseph and Charles Sts.	1882-1958
Lindsay	66 William St., S.E. corner of of William and Wellington Sts.	1881-1890
Listowel	46 Elma St. between Livingstone Ave. E. and Maitland River	1891-1915
London	Area bounded by Thames, Horton, Simcoe, Bathurst and Ridout Sts.	1853-1939
Napanee	96 Water St., S.W. corner of Water and West Sts.	1880-1921
Oshawa	1. West corner of Centre and Bond Sts.	1903 - before 1928
	2. 80 Emma St. at CN Railway Line (Old Prospect St.)	1901-1954
Ottawa	1. S.W. corner of York and King Edward Sts.	1854-1915
	2. 175 Lees Ave.	1920-1957
Owen Sound	1141-1145 First Ave. E.	1888-1947

COMMUNITY	ADDRESS	APPROXIMATE YEARS OF OPERATION
Peterborough	N. side of Simcoe St. between Queen St. and Railway Line, adjacent to Otonabee River	1869-1950
Port Hope	70-80 John St., W. side of John St. between Park and Alexander Sts.	1859-1938
Port Stanley	Carlow Road bounded by Marr Rd., Carlow Rd, Lake Rd, and George Street	1945-1958
St. Catharines	S. of Gale Crescent, bottom of Calvin St., beside Old Welland Canal	1853-1928
St. Thomas	Corner of Mondamin and Gas Sts.	1877-1935
Sarnia	Maxwell St. bounded by Maxwell, Water, Front Sts. and Railway tracks	1884-1909
Sault Ste. Marie	Goulais Ave. bounded by Bonney, Baseline, Pittsburgh and Goulais Sts.	1925-1963
Simcoe	S.E. corner of Pond and Water Sts.	1891-1910
Stratford	Wellington St., bounded by St. Patrick, Nelson, St. David and Erie Sts.	1879-1953
Toronto	1. Station A, 271 Front Street area of Princess, Berkeley, Front, Parliament and Trinity Sts.	1841-1954
	2. 415 Eastern Ave., N.E. corner of Booth St. and Eastern Ave.	1909-1954
	3. 28 Bathurst St., N.W. corner of Bathurst St. and Front St. W.	1909-1954
Waterloo	E. side of Regina St. and W. side of William St., S. of Laurel Creek	1889-1957

COMMUNITY	ADDRESS	APPROXIMATE YEARS OF OPERATION
Windsor	S. of McDougall Ave. opposite the S.W. extension of Brant St.	1871-1930
Woodstock	Young St. bounded by Young, Peel, Burtch Sts. and an open area	1876-1919

TABLE OF CONTENTSVOLUME 1

	Page
EXECUTIVE SUMMARY	i
LIST OF FIGURES	xi
LIST OF TABLES	xii
ACKNOWLEDGEMENTS	xiii
1. INTRODUCTION	1
1.1 Background	1
1.2 Objectives	2
1.3 Scope	3
2. HISTORICAL PERSPECTIVE	4
2.1 Gas Plant Operation	4
2.2 Coal Gasification Plant Wastes and Waste Characteristics	10
2.3 Behavior of Wastes in the Environment	14
2.4 Health Effects	17
3. STUDY METHODOLOGY	20
3.1 Phase 1 - Historical Record Search	20
3.1.1 Site Location Sources	20
3.1.2 Site Characterization Sources	23
3.1.3 General Assessment of Coverage	24
3.2 Phase 2 - Site Reconnaissance Visits	24
3.3 Phase 3 - Assessment of Potential Environmental Impact	27
3.3.1 Fact Sheet Description	27
3.3.2 Criteria for Assessment of Potential Environmental Impact	31
3.3.2.1 Site Characteristics	31
3.3.2.2 Evidence of Buried Wastes	35
3.3.2.3 Resource Characteristics	36
3.4 Phase 4 - Development of Options for Further Action	37

TABLE OF CONTENTS (cont'd)

	Page
4. RESULTS	38
4.1 List of Manufactured Gas Plant Sites	38
4.2 Preliminary Assessment of Potential Environmental Impacts of Manufactured Gas Plants	43
4.3 Site Descriptions of Manufactured Gas Plants in Ontario	46
4.3.1 Barrie	46
4.3.2 Belleville	49
4.3.3 Brampton	52
4.3.4 Brantford	54
4.3.5 Brockville	56
4.3.6 Cambridge (Galt)	58
4.3.7 Chatham	60
4.3.8 Cobourg	62
4.3.9 Cornwall	64
4.3.10 Deseronto	66
4.3.11 Dundas	68
4.3.12 Guelph	70
4.3.13 Hamilton - Industrial - Depew Street	72
4.3.14 Hamilton - Mulberry Street	74
4.3.15 Ingersoll	76
4.3.16 Kingston	78
4.3.17 Kitchener	80
4.3.18 Lindsay	84
4.3.19 Listowel	86
4.3.20 London	88
4.3.21 Napanee	92
4.3.22 Oshawa - Bond Street	94
4.3.23 Oshawa - Emma Street	96
4.3.24 Ottawa - King Edward Ave.	98
4.3.25 Ottawa - Lees Ave.	101
4.3.26 Owen Sound	104
4.3.27 Peterborough	106
4.3.28 Port Hope	109
4.3.29 Port Stanley	111
4.3.30 St. Catharines	114
4.3.31 St. Thomas	116
4.3.32 Sarnia	119
4.3.33 Sault Ste. Marie	121
4.3.34 Simcoe	123
4.3.35 Stratford	125
4.3.36 Toronto - Station A	127

TABLE OF CONTENTS (concluded)

	Page
4.3.37 Toronto - Station B	133
4.3.38 Toronto - Station C	137
4.3.39 Waterloo	139
4.3.40 Windsor	142
4.3.41 Woodstock	144
 5. OTHER SITES POSSIBLY RELATED TO COAL TAR WASTES	 147
5.1 Gas Plants Associated with By-Product Plants of the Steel Industry	147
5.2 Gas Plants Associated with Ammonia/Fertilizer Manufacturing	148
5.3 Manufactured Gas Plants for Industrial Light and Heat	149
5.4 Wood Preservative Plants	149
5.5 Pintsch Gas Plants	150
5.6 Manufactured Gas Plants for Metal Refining	151
5.7 Tar Distillation Industries	151
 REFERENCES	 153

LIST OF FIGURES

	Page
Figure 2.1 Intermittent Vertical Retort (ERT, 1984)	6
Figure 2.2 Continuous Vertical Retort (ERT, 1984)	6
Figure 2.3 Blue Gas Producer (ERT, 1984)	8
Figure 2.4 Carburetted Water Gas Producer (ERT, 1984)	8
Figure 2.5 An Example of a Gas Plant with both Retort Gas and Water Gas Facilities (Source: Fire Insurance Plan, Public Archives Canada, NMC-10837, 259/263)	9
Figure 2.6 Material Flow Schematic for a Typical Retort Gas Plant	11
Figure 2.7 Material Flow Schematic for a Typical Water Gas Plant (After Morgan, 1945, p. 1722)	12
Figure 3.1 Fact Sheet for Survey of Coal Gasification Plant Waste Sites.	28

LIST OF TABLES

	Page
Table 2.1 Typical Chemical Composition of a Coal Tar (After ERT, 1984)	15
Table 2.2 Carcinogenic Activity of Some Unsubstituted Polycyclic Aromatic Hydrocarbons (after ERT, 1983)	18
Table 3.1 Assessment Criteria for Potential Environmental Impacts of Manufactured Gas Plant Waste Sites in Ontario	32
Table 4.1 List of Manufactured Gas Plant Sites in Ontario	39
Table 4.2 Assessment of Potential Environmental Impacts of Manufactured Gas Plant Waste Sites in Ontario	44

ACKNOWLEDGEMENT

Through the course of this study Intera Technologies Ltd. (INTERA) have benefited from the assistance of numerous individuals, groups and organizations. INTERA would like to thank the following for their co-operation in this study and without whom the study would have been incomplete:

- Ontario Ministry of the Environment - Waste Management Branch
- Ontario Ministry of the Environment - Region and District Offices
- Consumers Gas Ltd. and Union Gas Ltd.
- The Communities and Municipalities of Ontario
- Private Property Owners
- Concerned Citizens

Margaret Carter of Heritage Preservation Research completed the search of historical records pertaining to coal gasification plants in Ontario.

1. INTRODUCTION

1.1 BACKGROUND

During spring and summer 1986, buried wastes were discovered in close proximity to sites which at one time were occupied by manufactured gas plants. Manufactured gas plants produced gas for illumination and heat in Ontario for over 100 years, from about 1850 to the late 1950's, by carbonization of coal or oil. Subsequent availability of electricity and natural gas caused many of the manufactured gas plants to be uneconomical and close down, some as early as 1890, many in the 1920's and 30's. In addition to combustible gas, gas plants produced tars, sludges, liquors and other gas cleaning wastes, that contain chemicals hazardous to human health. Although many of these by-products were sold for refining and reuse, some by-products were often buried at plant sites both during plant operation and plant demolition.

In May 1986, coal tar wastes, a by-product of manufactured gas production, were discovered in a transitway pumping station and in the adjacent Rideau River in the Regional Municipality of Ottawa Carleton. In July 1986, excavation for the construction of a new City Hall in Waterloo unearthed two large tanks containing coal tar wastes. At both of these sites, the buried wastes were encountered unexpectedly during excavation and were only associated with a former manufactured gas plant after review of historical records.

In response to the discovery of manufactured gas plant wastes in Ottawa and Waterloo, the Ontario Ministry of the Environment commissioned this study to identify and assess the potential environmental impact of former manufactured gas plant waste sites in the Province of Ontario.

The information collected during this study is expected to be of use to municipalities, land owners and developers and will likely form the basis for further investigations and possible remedial actions at individual sites.

1.2 OBJECTIVES

The objectives of this study were threefold:

- i) establish a comprehensive inventory of manufactured gas plant waste sites in the Province of Ontario;
- ii) assess the potential environmental impact of each identified waste site and;
- iii) develop options for further actions which more clearly define the chemical nature and physical extent of wastes and potential environmental impact at each site.

A four phase approach was adopted to meet the study objectives:

- Phase 1 - Historical record search
- Phase 2 - Site reconnaissance visits
- Phase 3 - Assessment of potential environmental impact
- Phase 4 - Development of options for further actions

More detailed descriptions of the study approach and each work phase are provided in Section 3 of this report.

1.3 SCOPE

This report describes the results of a study which provides an inventory and preliminary assessment of manufactured gas plant waste sites in the Province of Ontario. The study scope is restricted to waste sites that were associated with gas manufacturing for municipal illumination and heating, or so-called "town gas" facilities. Waste sites associated with industrial facilities that utilized coal carbonization for manufacturing of gas, coke, ammonia, and other products were not addressed in this study. These facilities include fertilizer plants, coke ovens, creosote plants and metal refining operations as well as large industrial users of manufactured gas. Many of these industrial sites remain in use today as controlled-access, industrial properties and therefore are likely of less concern than decommissioned and forgotten "town gas" waste sites. This study has also not considered secondary tar reprocessing and refining industries that utilized tars produced by the carbonization of coal and oil in the manufacturing of various oils, coatings and refined tar products. These facilities include roofing tar plants, creosote or wood preservative plants, and varnish and tar paper manufacturing facilities.

Section 5 of this report summarizes the waste sites identified during this study that were not associated with "town gas" plants and were not within the terms of reference of this study as defined above. This listing is not complete and is presented to provide an indication of other types of facilities that handled or generated wastes similar to those associated with "town gas" plants. The inventory and assessment of "town gas" waste sites is as complete as historical records will allow.

2. HISTORICAL PERSPECTIVE

2.1 GAS PLANT OPERATION

In Ontario, the use of gas manufactured from coal or oil began in the mid 1800s and continued until the mid 1950s. In the late 1800s and early 1900s many gas plants were initiated to provide gas for street lights, appliances, furnaces and some industrial engines. A local gas operation was considered an economic benefit to the community and a source of considerable civic pride. Consequently, the operation of the gas facilities were typically taken over from private owners by the municipality early in the life of the gas plant and operated as a local utility in much the same manner as hydroelectric power is today.

Most of the gas plants in Ontario were operated until a more economical source of gas or hydroelectric power was available. In some communities in Southern Ontario, gas was available from natural gas fields and therefore city operated gas plants may have had short lives or were operated intermittently. Many communities also depended heavily on hydroelectric power and may not have required gas or received gas via pipelines from adjacent communities. By the early 1950s inexpensive natural gas, brought to Ontario by pipeline from western Canada, made most manufactured gas plants obsolete.

Many different types of gas generating processes were in operation in Ontario, and many gas plants used several different processes or changed the manufacturing process during the life of the plant. Essentially, the process consisted of heating coal whereby the gaseous (volatile) components of the coal are removed and collected. The different processes for generating gas result from the various methods used to separate the volatile components from the coal. Types of manufactured gas, each using a slightly different process, include

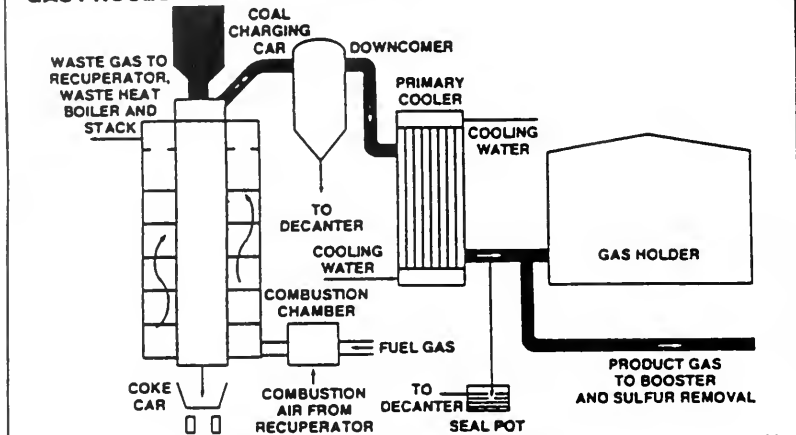
the following:

- coal carbonization;
- blue gas;
- water gas; and
- producer gas.

An excellent review of manufactured gas processes and environmental aspects of gas plants is provided by Environmental Research and Technology Inc. (ERT) and Koppers Company Inc. (1984). Many of the following descriptions of gas processes were taken from this comprehensive handbook.

Coal carbonization involves the treatment of coal by heat at either low or high temperatures in the absence of air to drive off the volatile components from the coal. The resultant products are a fuel gas and coke. The carbonizing of coal can be achieved in gas retorts or coke ovens. Gas retorts are essentially large, semi cylindrical, fire brick or silica ovens with the axis of the cylinder oriented either horizontally, inclined or vertically. The vertical retort was the most common and consisted of either an intermittent or a continuous method of recharging the coal. The intermittent vertical retort (Figure 2.1) carbonizes the coal in batches while the continuous method (Figure 2.2) recharges the coal on a continuous basis. Gas produced by the retort method is generally high in hydrogen, methane, and carbon monoxide with a heating value of about 525 Btu/ft³ (ERT, 1984). Coke ovens are similar in concept to gas retorts in that coke is derived from bituminous coal from which the volatile constituents have been driven off by heat. The volatile constituents, after removal of tars, ammonia and other impurities yield a gas of high heating value. Coke ovens are typically by-product gas producers simply because they are used primarily to produce metallurgical coke for use in steel making.

U.G.I. INTERMITTENT RETORT GAS PROCESS FLOW



KOPPERS-van ACKEREN CONTINUOUS RETORT GAS PROCESS FLOW

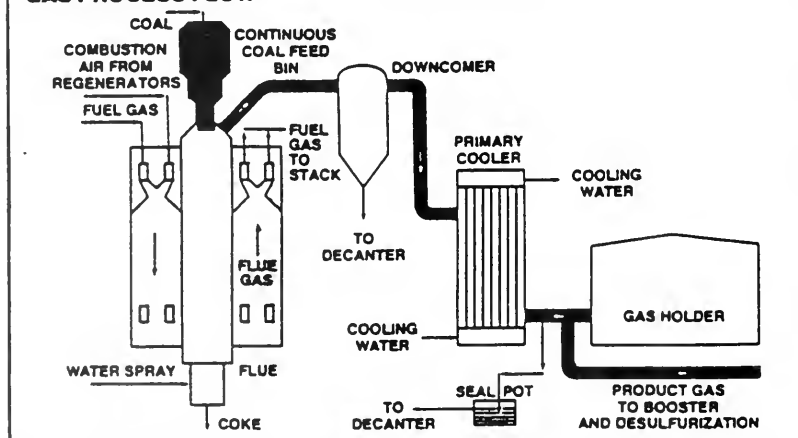


Figure 2.1 (Top) Intermittent Vertical Retort

Figure 2.2 (Bottom) Continuous Vertical Retort

(ERT, 1984)

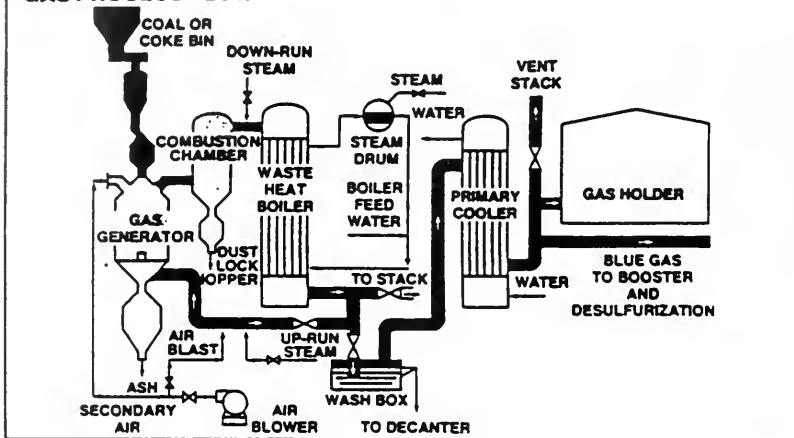
Blue gas, produced by passing steam over incandescent coke, results in the production of a gas composed predominantly of carbon monoxide and hydrogen gas. The production of blue gas is completed in a cyclic operation. Initially the coke is combusted with the aid of blasts of air. Once the coke reaches a high temperature the air is shut off and steam is introduced through the coke bed generating the blue gas. Because the introduction of steam cools the coke beds it is necessary to interrupt the gas generation periodically to reheat the coke beds with air blasts. The blue gas has a heating value of about 300 Btu/ft³. An example of a blue gas producer is shown in Figure 2.3.

Water gas or carburetted water gas (Figure 2.4) is produced by cracking oil in the presence of blue gas and steam. The method is similar to that used for blue gas except that oil is added to the blue gas in a carburetor to form a blue gas/oil gas and steam mixture. The oil gas is then cracked (i.e., the oil is reduced to lower hydrocarbon gases) in a superheater and cleaned in a wash box to produce a gas of high heating value (up to 1000 Btu/ft³ but typically 530 Btu/ft³). As in the production of blue gas, water gas production is done on a cyclic basis.

Producer gas is obtained by the partial combustion of coal or coke in air. This gas was typically associated with coke oven batteries and was used to underfire the ovens thus generating increased quantities of the more valuable coke oven gas. Producer gas was typically low in heating value (less than 200 Btu/ft³).

In Ontario, most of the gas plants started out as retort gas plants and those plants that continued into the 1920's or 30's were either converted to water gas plants or had water gas facilities added to the site. An example of a gas plant (Ottawa Lees Avenue, 1922) with both retort gas and water gas facilities is shown in Figure 2.5.

BLUE GAS PRODUCER GAS PROCESS FLOW



CARBURETTED WATER GAS PRODUCER GAS PROCESS FLOW

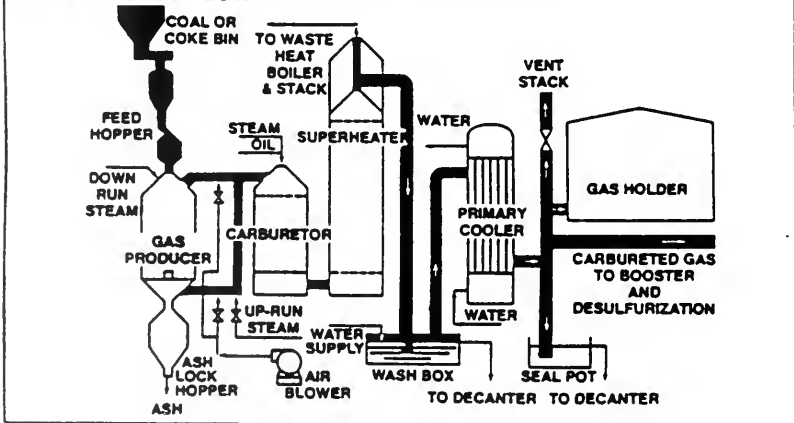


Figure 2.3 (Top) Blue Gas Producer

Figure 2.4 (Bottom) Carburetted Water Gas Producer
(ERT, 1984)

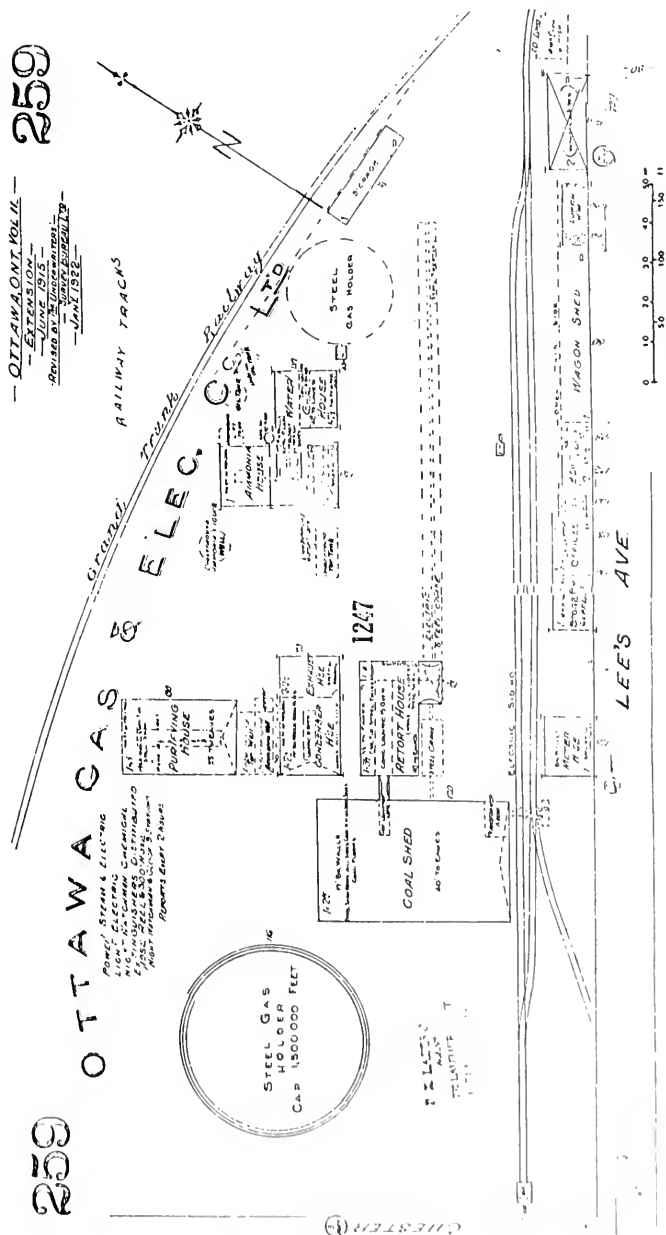


Figure 2.5 An example of a gas plant with both retrofit gas and water gas facilities. (Source: Fire insurance plan, Public Archives Canada, NMC-10837, 259/263)

Drawn by	Date
Checked by	Date
Revisions	Date

INTERA Technologies

Regardless of the method used to produce the gas it was necessary to clean the gas to make a useable product for consumers. The clean-up techniques consisted of cooling the gas and condensing and removing tars, liquors, and sludges followed by sulfur removal using oxide boxes. The processes for cleaning the gas are shown schematically in Figure 2.6 for a retort gas operation and in Figure 2.7 for a water gas plant. Most of the facilities shown in Figures 2.6 and 2.7 are indicated on the gas plant layout shown in Figure 2.5.

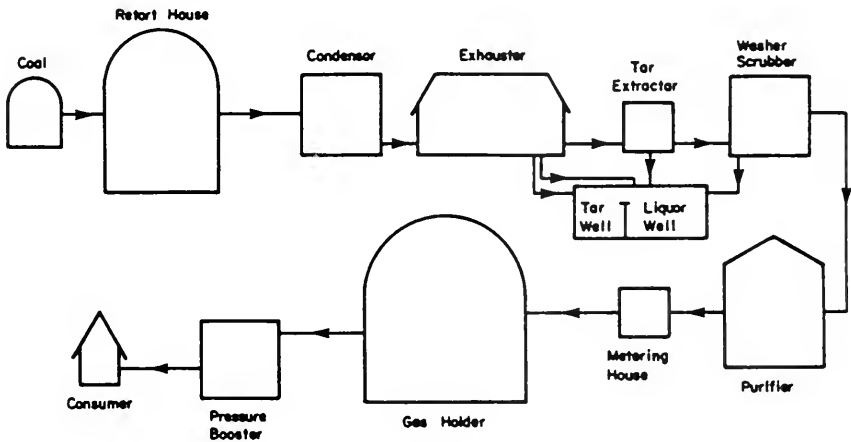
2.2 COAL GASIFICATION PLANT WASTES AND WASTE CHARACTERISTICS

The major types of wastes and by-products generated in the coal gasification process include:

- tars;
- sludges;
- tar liquors and ammonia liquors;
- spent iron oxide;
- ash, slag, cinders;
- dust, off-grade coal and coke.

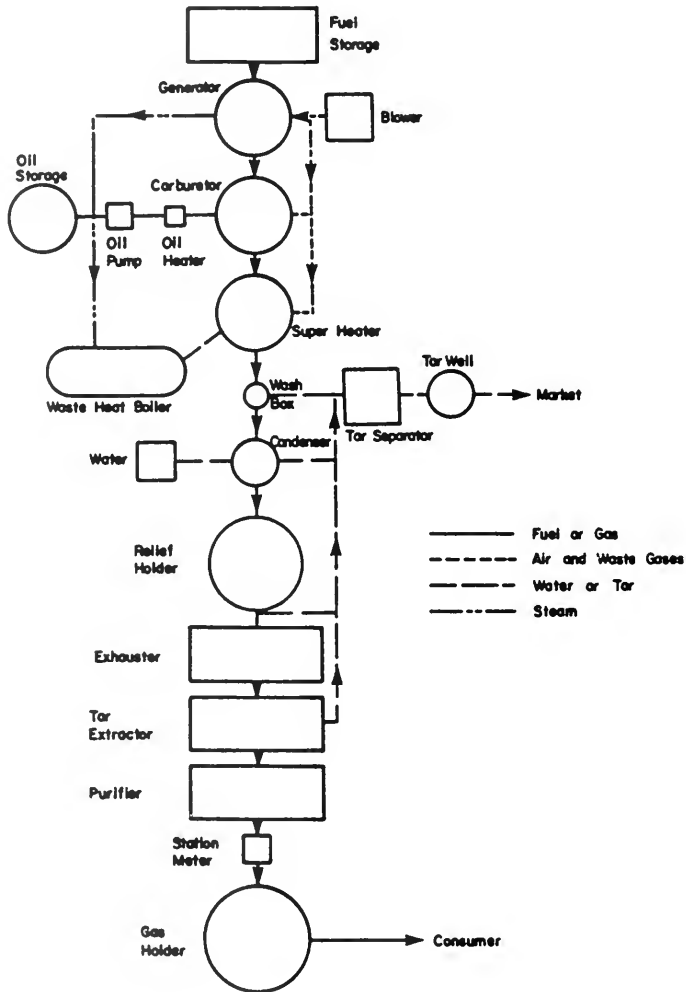
From an environmental hazard point of view, the important gas plant wastes are tar residues and sludges and spent oxide wastes.

Tar residues and sludges are produced in the gas clean-up process during the cooling, condensation and scrubbing of the raw gas. On-site tar storage areas, consisting of underground tanks or wells, are usually found adjacent to the condenser or purifying houses. Tar dehydrators and tar separators will also contain tar and may be found as underground or above ground storage tanks. Pipelines running from the production areas to the tar storage areas may also contain tar.



Drawn by	Date
Checked by	Date
Revisions	Date

Figure 2.6 Material flow schematic for a typical retort gas plant



Drawn by	Date
Checked by	Date
Revisions	Date

Figure 2.7 Material flow schematic for a typical water gas plant (After Morgan, 1945, p. 1722)

Other locations of residual tar may be associated with the base of the relief gas holder which would have contained raw gas prior to clean-up and to a lesser extent the base of the main gas holding tank.

The tar produced at a gas plant was considered a valuable by-product and was often sold to tar distillation plants or domestic consumers. The off-site distillation plants refined the tar to produce such products as naphthalene, creosote, heavy oil, and roofing and road tars. Consequently, little tar was likely to be disposed on-site except when production was greater than demand or where spillage might occur in loading areas. Tar remaining on-site after plant demolition may be found in the original storage areas if the containers are intact. If storage tanks or other tar containing structures are ruptured during demolition or other on-site excavation or construction, free tar and tar contaminated soil may be widespread across the plant site.

Coal tar and coal tar contaminated material is easily identifiable when encountered because of its distinctive odour which resembles creosote or roofing tar. The tar is typically a brown to black resinous material with a consistency varying from a light oil to a heavy tar. It is immiscible with, and heavier than, water and therefore exhibits density - dependent flow characteristics. When in contact with surface water, coal tar may release a lighter-than-water phase which causes an oily sheen on the water surface.

Immiscible coal tar in surface water will sink to the bottom of the water body and will collect in depressions.

Spent oxide is a waste product that resulted from the removal of sulphur and nitrogen-containing impurities from the manufactured gas by adsorption onto iron oxide (ERT, 1984). These wastes contain high concentrations of sulphur, cyanide, and ammonia compounds, most of which are chemically bound with iron. Their characteristic blue-grey

colour caused by ferrocyanide complexes make them readily identifiable upon discovery. Such identification is possible in soils with little as 1% spent oxide.

Oxide wastes were typically disposed of on-site or adjacent to the site using standard landfilling techniques of the time.

The ash, slag, clinkers, dust and offgrade coal and coke were often disposed on-site or as part of adjacent landfilling operations. These wastes are relatively inert, although they may leach traces of heavy metals.

2.3 BEHAVIOUR OF WASTES IN THE ENVIRONMENT


























The major chemicals associated with gas plant waste that may pose an environmental hazard are:

- Polynuclear aromatic hydrocarbons (PAH);
- Phenols;
- Light aromatics;
- Inorganic sulfur and nitrogen species;
- Trace metals.

PAH, phenols and light aromatics are derived primarily from the tar sludges and liquors. Table 2.1 (after ERT, 1984) shows the typical chemical composition of a coal tar. Inorganic species and trace metals are derived primarily from the oxide box wastes and the ammonia liquors. Trace metals may also be generated to a lesser extent from disposal of ashes and cinders.

The tars are mainly made up of polynuclear aromatic hydrocarbons which are compounds consisting of two or more fused benzene rings. PAH compounds are those listed below pyridine in Table 2.1. The physical properties of PAH are dependent on the

Table 2.1 Typical chemical composition of a coal tar
(After ERT, 1984)

Component	Formula	Structure	Boiling Point, °C(a)
Benzene	C_6H_6		80
Toluene	C_7H_8		111
Xylenes	C_8H_{10}		138-144
Phenol	C_6H_5OH		181
Cresols	C_7H_7OH		191-202
Xylenols	C_8H_9OH		201-227
Pyridine	C_5H_5N		115
Naphthalene	$C_{10}H_8$		218
Methylnaphthalenes	$C_{11}H_{10}$	-	241-245
Dimethylnaphthalenes	$C_{12}H_{12}$	-	262-269
Acenaphthene	$C_{12}H_{10}$		277
Carbazole	$C_{12}H_9N$		355
Fluorene	$C_{13}H_{10}$		297
Anthracene	$C_{14}H_{10}$		340
Phenanthrene	$C_{14}H_{10}$		340
Fluoranthene	$C_{16}H_{10}$		393
Pyrene	$C_{16}H_{10}$		394
Chrysene	$C_{18}H_{12}$		436
Benz(a)anthracene	$C_{18}H_{12}$		438
Benzo(j)fluoranthene	$C_{20}H_{12}$		~480
Benzo(k)fluoranthene	$C_{20}H_{12}$		480
Benzo(a)pyrene	$C_{20}H_{12}$		496
Benzo(e)pyrene	$C_{20}H_{12}$		493
Perylene	$C_{20}H_{12}$		460
Benzo(g,h,i)perylene	$C_{22}H_{12}$		500
Benzo(b)chrysene	$C_{22}H_{14}$		~500
Dibenz(a,h)anthracene	$C_{22}H_{14}$		-

structure of individual compounds. The aqueous solubility of each compound decreases as the molecular weight of the compound increases. Therefore those compounds with a simple structure have higher solubilities than those with a complicated structure. A similar relationship exists for volatility of PAH as is shown in Table 2.1 by the increase in boiling point temperature with increase in molecular weight. PAH are strongly absorbed and immobilized in soils and are also susceptible to biodegradation by microorganisms. As a result of these properties, PAH tend to be relatively immobile in the environment. However, the fact that they occur in tars and that tars can migrate as an immiscible heavier-than-water phase increases their mobility and potential environmental impact.

Phenolics (e.g., phenol, creosol and xyleneol in Table 2.1) are highly soluble with low sorption and high biodegradability and therefore are expected to be highly mobile in groundwater.

Light aromatics, such as benzene, xylene and toluene (Table 2.1) are moderately soluble, and biodegradable with high volatility and low sorption. They are expected to be relatively mobile in groundwater systems. However the presence of these compounds will be largely determined by their volatility. It is unlikely that benzene or toluene would be detected in waste products that have been exposed to air for any significant period of time.

Inorganic sulphur and nitrogen species are usually stable under most normal pH and Eh conditions in groundwater systems. Ammonia and cyanide in spent oxide wastes may be leached under acidic conditions, but these compounds are also known to readily biotransform in aerated soils to simpler nitrite and nitrate compounds.

Most trace metals leached from manufactured gas plant wastes are relatively insoluble and highly sorbed.

2.4 HEALTH EFFECTS

The environmental impact and risk associated with manufactured gas plant wastes are derived from exposure and/or contact with hazardous substances. The hazardous substances of primary concern in this respect are associated with coal tar wastes, particularly polynuclear aromatic hydrocarbons and light aromatic hydrocarbons (ERT, 1983; 1984). The environmental impact from these substances results in adverse effects on human health and aquatic and terrestrial ecosystems. The most adverse effect associated with PAH and light aromatic hydrocarbons, is the increased incidence of cancer (ERT, 1984). Health effects associated with PAH are documented in the literature because of their ubiquitous presence in the environment. PAH are found in polluted air, tobacco smoke, cooking products, soots, tars, and oils. PAH are formed in a variety of hydrocarbon combustion processes routinely exposing most people to very low levels of PAH. In general, PAH are a large group of chemicals (Table 2.1) of which only a few have been suitably tested with respect to human health effects. The major routes of PAH adsorption are through inhalation and cutaneous exposure (Occupational Health Program, McMaster University, 1986).

The carcinogenic activity of various PAH is given in Table 2.2 from ERT (1983). In general, the toxicity of PAH in various species increases as the molecular weight of the compound increases. This effect is tempered somewhat by differences in solubility in that the heavier compounds are less soluble and, therefore, less mobile in aqueous environments. PAH are noted to bioaccumulate in animal tissue of aquatic organisms and also are accumulated by adsorption in plants. The adsorption tends to be onto root surfaces as opposed to into the plant structure and, therefore, does not accumulate in the plant itself.

Single ringed, light aromatic hydrocarbons found at manufactured gas plants generally consist of the toxic compounds benzene, toluene, xylene and ethylbenzene. Of these compounds, benzene

Table 6.1 Carcinogenic Activity of Some Unsubstituted Polycyclic Aromatic Hydrocarbons^(a) (ERT, 1983)

Compound	Activity
Acenaphthylene	-
Anthanthrene	-
Anthracene	-
Benzo[a]naphthacene	-
Benzo[a]pyrene	+ (c,d)
Benzo[a]fluorene	-
Benzo[b]chrysene	-
Benzo[b]fluoranthene	+ (c,d)
Benzo[b]fluorene	-
Benzo[c]chrysene	-
Benzo[c]fluorene	+
Benzo[c]phenanthrene	+
Benzo[e]pyrene	+
Benzo[g]chrysene	+
Benzo[ghi]fluoranthene	-
Benzo[ghi]perylene	+
Benzo[j]fluoranthene	+ (c)
Benzo[k]fluoranthene	-
Benz[a]anthracene	+ (c,d)
Chrysene	+ (c)
Coronene	-
Dibenzo[a,e]pyrene	+ (c,d)
Dibenzo[a,h]pyrene	+ (c,d)
Dibenzo[a,i]pyrene	+ (c,d)
Dibenzo[a,j]naphthacene	-
Dibenzo[a,l]pyrene	-
Dibenzo[b,g]phenanthrene	-
Dibenzo[b,k]chrysene	-
Dibenzo[de,qr]naphthacene	-
Dibenzo[e,l]pyrene	+
Dibenz[a,c]anthracene	+
Dibenz[a,h]anthracene	+ (c,d)
Dibenz[a,j]anthracene	+
Fluoranthene	-
Fluorene	-
Hexacene	-
Indeno[1,2,3-cd]pyrene	+ (c,d)
Naphthacene	-
Naphthalene	-
Naphtho[2,3-b]pyrene	+
Pentacene	-
Pentaphene	-
Perylene	-
Phenanthrene	-
Picene	-
Pyrene	-
Tribenzo[ace]pyrene	+
Triphenylene	-

^aData from Shear, 1938, 1941; Arcos and Argus, 1974; Dipple, 1976; Santodonato et al., 1981

^bSymbols: + complete carcinogen by either skin painting, subcutaneous injection, intramuscular injection, intravenous injection, intraperitoneal injection, intratracheal instillation, oral administration to mammals
- negative in animal bioassay

^cCompounds classified as "having substantial evidence of carcinogenicity" by the U.S. EPA Carcinogen Assessment Group (U.S. EPA, 1980b). The CAG list also includes two alkylated PAH (7, 12-dimethylbenz[a]anthracene and 3-methylcholanthrene), as well as "coal tar and soot", "coke oven emissions (polycyclic organic matter)" and "creosote".

^dCompounds classified as showing "sufficient evidence" of carcinogenicity for animal carcinogens by the International Agency for Research on Cancer.

is the most toxic because of its carcinogenic health effects (USEPA, 1980a). The common method of human exposure is by inhalation due to the volatile nature of the light aromatics.

Chronic exposure to benzene has the most serious health effects of the light aromatics because of its increased risk for the development of Leukemia (ERT, 1984). All of the light aromatic hydrocarbons affect the central nervous system with acute symptoms including headache, dizziness, fatigue, nausea, unconsciousness and coma.

In aquatic ecosystems, the light aromatic hydrocarbons are moderately toxic to fish and lower species. Toxic levels of benzene, toluene, and xylene generally range from 1 to 100's of $\text{mg}\cdot\text{L}^{-1}$. For example, rainbow trout was found to have an LC-50 (lethal concentration for 50 percent of the population) of $5.3 \text{ mg}\cdot\text{L}^{-1}$ for benzene (USEPA, 1980a).

A recent Ontario Ministry of Labour sponsored study, (Occupational Health Program, McMaster University, 1986) provides a comprehensive review of the available scientific evidence relating to health effects of coal tar and other substances which contain polynuclear aromatic hydrocarbons. This study concludes that there is sufficient evidence concerning human carcinogenic potential of coal tar products in the literature to warrant stringent control of workplace exposures. This study recommends an interim standard for occupational exposure to volatiles of coal tar products at $0.05 \text{ mg}/\text{m}^3$ (cyclohexane soluble extract) time weighted over an 8 hour working day and zero dermal exposure.

3. STUDY METHODOLOGY

3.1 PHASE 1 - HISTORICAL RECORD SEARCH

The search of historical records was undertaken to provide a list of manufactured gas plant waste sites. This involved the identification of manufactured gas plant sites as well as any historical information describing possible off-site disposal of gas plant wastes. Only limited data describing the off-site disposition of gas plant waste was available from historical records. Therefore, the review of historical records focussed on identification and characterization of manufactured gas plants sites.

The method used in this phase relied upon review of a limited number of well selected historical sources to both identify the existence and exact location of sites, and to obtain a comparative, shallow level of information for each site. The key to this method was the selection of appropriate historical source materials. The historical source materials used in this study of listed in Appendix A. Historical source materials can be grouped by use according to site location and site characterization tasks.

3.1.1 Site Location Sources

Sources used for the identification of manufactured gas plant locations varied from period to period. In each case, they were selected by the following criteria: comprehensiveness of coverage, degree of reliability of information contained, degree of site specificity of information contained, potential for including other information (i.e., on relative size, equipment or processes) of relevance to the general purposes of the study.

The sources used to obtain information in various periods are listed as follows:

- 1850-1870 - lists of Canadian gas plants included in the North American gas industry publication, the American Gas-Light Journal. This information was cross-checked in Ontario Directories for the period.
- 1870-1905 - lists of Canadian gas plants included in published Census material which, for this period are very specific about location, number of employees. This information was further developed by use of the Baudouin Index to Incorporated Bodies, which provided a list of the gas companies permitted to operate gas plants during the period (whether they actually did or not), and refined through the use of both general business directories of the province of Ontario and local directories when they were available. Directory sources were selected as they provide an immediate picture of annual developments. In a few cases, community historical societies and archives were consulted to confirm the existence of plants that proved impossible to verify.
- 1905-1920 - after the founding of the Canadian Gas Association, the association provided detailed listings of the names, locations, equipment, methods and ownership of gas plants operating in the province in its monthly Intercolonial Gas Journal. This material was further

developed by information obtained through Ontario government records on company incorporations, and Ontario Energy Board franchise agreements and by-laws. It was also cross-checked with information on municipally owned utilities contained in the report of the Select Committee on Municipal Trading and Municipal Ownership of Public Utilities, 1903.

- 1919-1959 - after the Dominion Bureau of Statistics was established in 1918, yearly lists of plants producing "Gas for Illumination and Fuel Purposes" were issued, as were lists of plants in the "Coke and Coke By-Products" industry. Until 1939, these lists were issued under the Non-Metallic Minerals category; after 1940 they are issued as separate reports on the coke and gas industry. These reports were followed until the category "Gas for Illumination and Fuel Purposes" ended in 1959.

This material was further developed by information obtained from Ontario government records of the Ontario Energy Board, and correspondence of the special fuel controller appointed in the province in 1922-28 to co-ordinate the disposition of scarce coal resources. Later (post 1955) listings were cross-checked in the Canadian Gas Association's Directory of Canadian Gas Utilities.

3.1.2 Site Characterization Sources

Every attempt was made to obtain a description of the evolution of various manufactured gas plant sites over time to ensure changes in their disposition over time (and therefore a record of landfill, buried tanks, and changed location of gas holding tanks) was recorded.

Historical sources used for the early period included Bird's Eye views, county maps, and county atlas material, selected in each case for the specific details included on site disposition.

Once fire insurance plans appeared in any community, they became the major source used. Such plans were reviewed whenever they existed, although only those showing site changes, or a range of time (i.e., earliest and latest) were purchased. Review of these sources was restricted to the three major collections of fire insurance plans in the province, those at the Public Archives of Canada, Ottawa, the Ontario Archives, Toronto, and the Regional Collection at the University of Western Ontario, London. Enquiries were made to local archives when plans for specific communities were not available in the major collections, and some additional materials have been obtained in this way. Corporate archives such as those of Ontario Hydro and Consumers Gas were also contacted and additional site specific information was obtained from these sources. The preparation of fire insurance plans stopped in the late 1950s, and such plans are not available for many communities after the 1930s or 1940s.

Some additional maps of gas plant operations were obtained from current Public Utilities Commissions who at one time owned or operated manufactured gas plants in individual towns and cities.

3.1.3 General Assessment of Coverage

The inventory aspects of this study (i.e., the identification of manufactured gas plants constructed for the purpose of municipal illumination and heating) have been carefully covered in a clear and methodical fashion. The resultant inventory is thought to be as complete as sources of general manufactured gas data and specific historical mapping techniques allow.

While the coverage provided by the review of historical records is thought to be comprehensive and verified by cross referencing between sources, it is possible that small manufactured gas plants that operated for periods of less than 10 years may not be identified. Such an omission, if it occurred, is not expected to be significant because of the likely small volume of wastes generated by such a facility and the low potential environmental impact demonstrated by similar-sized sites that were identified in this study.

Assessment of the reliability of the inventory aspects of this study is also provided from the results of similar identification studies undertaken in parallel by Consumers Gas Co. Ltd. and Union Gas Ltd. for their respective gas distribution areas in Ontario. The results of the inventory aspects of the study reported herein are consistent with manufactured gas plants identified in these other studies.

3.2 PHASE 2 - SITE RECONNAISSANCE VISITS

Reconnaissance visits and on-site inspections were undertaken for all plant sites, except the Sault Ste. Marie site, identified from Phase 1 activities. The principal purpose of site reconnaissance and inspection was to identify any evidence of wastes by visual and olfactory inspection and any environmental impacts that may be related to the wastes. The site reconnaissance also served to identify land

use on-site and off-site, site conditions and site access for possible future investigations and to obtain photographs of and additional local information on the site. Waste site reconnaissance work undertaken as part of this phase did not involve subsurface investigations, such as drilling and soil sampling.

The approach to site reconnaissance was to utilize a consistent and thorough inspection of the waste site in conjunction with available air photos, gas plant plans, and plans of underground utilities including storm sewers.

The data collected from site reconnaissance visits included:

- Visual evidence of tarry wastes and spent oxide wastes at surface and, in the near surface;
- Olfactory evidence of wastes both on- and off-site;
- Visual evidence of water pollution in surface waters and groundwaters;
- Confirmation of current land use both on- and off-site;
- Resource characteristics including proximity to and usage of surface water and groundwater resources.

Because of the visual character of tarry wastes and spent oxide wastes (see Section 2.2), these gas plant wastes were in principle relatively easy to identify at surface and in the near surface. These wastes also pose the most significant potential health and environmental impact. Cinders, ash, coal fines and clinkers were also readily identified but these materials pose little health or environmental hazard and were only used to confirm the location of the gasification plant.

Odours are noticeable and characteristic at former manufactured gas plants as a result of the presence of lower molecular weight volatile organics (i.e., naphthalene, benzene, toluene, xylenes) in gas plant wastes. Organic vapour concentrations of $1 \mu\text{g}\cdot\text{L}^{-1}$ (ppb) are detectable by sense of smell.

Visual evidence of water pollution by oily and tarry gas plant wastes was also evaluated. Because of the immiscible and denser-than-water properties of tars and aludges, natural and manmade catch basins, surface drainage ditches, storm water outfalls and natural seepage faces on soil and rock slopes were examined. Additional and important locations where these wastes may accumulate in developed areas are building sumps, tile drains and in storm water sewers and sumps.

Site inspections were performed during February 1987. At this time of the year, the inspection of ground conditions and surface water conditions was hampered by the presence of snow and ice. The detection of odours was also reduced at this time of year as a result of lower air temperatures. Because of these considerations, increased evidence of buried wastes may be detected at some of the sites if the inspections are conducted in warmer weather. To compensate for the reduction in data quality attributed to winter weather, increased effort was extended in examination of building sumps, catch basins, and manholes as well as the collection of soils studies, geotechnical investigations and excavation reports associated with sewer construction or redevelopment on or near each site.

3.3 PHASE 3 - ASSESSMENT OF POTENTIAL ENVIRONMENTAL IMPACT

Assessment of potential environmental impact of each gas plant site was performed using a fact sheet that describes site conditions and qualitative assessment criteria.

3.3.1 Fact Sheet Description

The fact sheet has the purpose of presenting all relevant site specific information in a format that is consistent and comprehensive. The fact sheet utilized in this study is given in Figure 3.1 and is based in part on one suggested by ERT (1984). The fact sheet is structured into several categories based in part on assessment criteria. The categories include site location, site identification, site characteristics, evidence of buried wastes, resource characteristics, comments and off-site waste disposal areas. The entries to the fact sheet are mostly self explanatory; however, a brief description is appropriate.

Site location is documented in terms of regional and local address. Regional location is identified by Ontario Ministry of the Environment region and district as well as city or town and National Topographic Service map sheet number. Local address is given as a municipal address using street and number and/or bounding blocks. Local gas plant location is also given on a city street map and shown on an historical map. Available historical maps are listed on the fact sheet.

Each site is identified by a name that usually refers to the gas plant facilities and by the type of facility and operator(s) and period(s) of operation of the facility.

Figure 3.1 Fact Sheet for Survey of Coal Gasification Plant Waste Sites

1. Site Locations:

City _____ Street Address _____
Town _____
MOE Region _____
MOE District _____ NTS Map Sheet _____
Historical Maps Available _____

2. Site Identification:

Name _____
Type of Facility _____
Operator(s) and Period(s) of Operation _____

3. Site Characteristics:

Size (when operated) _____
Present Land Use _____

Planned Land Use _____
Present Occupant(s) _____

Present Land Use Adjoining Properties _____

Underground Utilities _____

Soil Conditions _____

Site Access _____

4. Evidence of Buried Wastes:

Operating Period _____

Excavation History _____

Visible Wastes _____

Odour _____

Water Pollution _____

5. Resource Characteristics:

Surface Water _____

Proximity _____

Use _____

Groundwater, Proximity _____

Use _____

Proximity of Existing Wells _____

Site Investigations _____

6. Comments/Remarks: _____**7. Off-Site Disposal Areas:** _____

Site characteristics include the plant size (areal extent when operating) present and planned land use, present occupants or owners, and land use of surrounding properties. Description of underground utilities, soil conditions and site access are also provided in this category.

The evidence of buried wastes category includes duration of operations (longer operating periods are likely to generate more wastes), the history of excavation at the site and any reported or observed visible or olfactory evidence of wastes. Evidence of water pollution is also included in this category.

The resource characteristics category include identification of natural resources, such as surface and groundwater resources in the area of each site that potentially may be impacted by waste migration. Historical or on-going site investigations that provide additional information on each site are also noted in this category.

A comments and remarks section is also provided to allow description of important aspects of the site not covered by previous categories.

The last category of the fact sheet describes the disposition of gas plant wastes off-site. This disposal includes that undertaken during plant operation and later during excavation and redevelopment. For most plant sites, the location and extent of off-site waste disposal is not well known. Most off-site waste site locations are only tentatively identified. Because of this uncertainty and the likelihood that other industrial wastes may have been disposed at such sites, off-site disposal areas were not subject to assessment of potential environmental impact.

3.3.2 Criteria for Assessment of Potential Environmental Impact

The criteria for assessment of potential environmental impact of manufactured gas plant sites are listed in Table 3.1 and are grouped into three important categories: site characteristics, evidence of buried wastes and resource characteristic as suggested by ERT (1984). The three categories are further divided into a number of factors which are used to assess the potential environmental impact of each site. The approach to assessment of potential environmental impact of unexplored gas plant sites is qualitative in nature reflecting the variable, uncertain and conjectural nature of much of the data. Therefore, qualitative scores of high, medium, and low are assigned for each of the factors. For some sites, data is of greater reliability as a result of recent subsurface investigations, but for many of the sites reliable information on subsurface conditions is not available, or at best is poorly reported. Given these considerations, quantitative assessment or ranking of sites with respect to potential environmental impact is not warranted. Also not all factors are expected to have equal weighting at all sites.

The rationale and assessment criteria for each factor are provided in the following paragraphs.

3.3.2.1 Site Characteristics

Size. This factor provides a good indication of the potential impact of a site in that a large site is more likely to be a problem than a small site. Large sites would tend to be associated with larger plants that would produce more waste and, therefore, have a greater potential for waste products to enter the environment. Large sites are considered to be greater than 1.0 ha (10,000 m²) while small sites are less than 0.5 ha and these values represent the bounds for high and low scores.

Table 3.1 Assessment Criteria for Potential Environmental Impacts of Manufactured Gas Plant Waste Sites in Ontario

Factors	Criteria for Assessment		
Level	Low	Medium	High
<u>Site Characteristics</u>			
Size (when operated)	<0.5 hectares	0.5-1.0 hectares	>1.0 hectares
Location	rural or sparsely populated	industrial or commerical area	residential or public use area
Current Use/Ownership	controlled access, industrial or commercial use	owned and used industrially or commercially with uncontrolled access	used residentially or publicly
Planned Use/Ownership	continued owner-ship and industrial or commerical use	sale for industrial or commerical use	sale or conversion to residential or public use
Potential for Excavation	no plans for redevelopment	possible redevelopment	redevelopment planned
<u>Evidence of Buried Wastes</u>			
Operating Period	<30 years	30-60 years	>60 years
Excavation History	excavation, no wastes reported	no excavation	excavation, waste encountered
Visible Wastes (Tars and Spent Oxide)	none or very minor	minor pockets	extensive
Odour	none on-site	minor on-site	distinct on-site
Water Pollution	no visible presence	oily or discoloured water on-site	oily or discoloured drainage off-site

Table 3.1 Assessment Criteria for Potential Environmental Impacts of Manufactured Gas Plant Waste Sites in Ontario

Factors	Criteria for Assessment		
Level	Low	Medium	High
<u>Resource Characteristics</u>			
Surface Water Proximity	>1 km	<1 km but not adjacent	adjacent
Surface Water Use	industrial	recreational	drinking water
Groundwater Proximity	site directly on low permeability soils or bedrock	site on permeable soils with confining layer above aquifer	direct ground-water connection to major aquifer
Groundwater Use	no wells in possible impacted areas	industrial or a few private wells	public water supply wells

Location. Gas plant locations are an important consideration in the assessment of a site because the location will determine the potential for human contact. Sites located in rural areas will have a low population density and, therefore, the potential population affected by a contaminant release will be small. Similarly, if the area is industrial or commercial, more people are likely to be affected. The highest ranking is given to a site that is now located in a residential or public use area.

Current Use/Ownership. This factor is used to assess public access and the potentially affected populations. If the site ownership is presently industrial or commercial, access may be limited and the potentially affected population is reduced. Conversely, if the site is residential or public, access will be uncontrolled resulting in a greater concern and a higher ranking.

Planned Use/Ownership. This factor considers the potential impact on future populations similarly to the current use/ownership factor. A high ranking is given to sites that have the potential for sale or conversion to residential or public use. Also a site planned for resale is assuming all other considerations being equal, likely to be of greater concern from the standpoint of legal liability than a site that will be kept.

Potential for Excavation

This is an important factor in that it directly assesses the likelihood that buried wastes may be excavated and exposed and dispersed through rupturing of underground tanks. From a health standpoint, wastes contained in tanks in the ground pose much less hazard than wastes exposed during excavation. Consequently, sites planned for redevelopment are of greatest concern whereas sites with no plans for redevelopment are of least concern.

3.3.2.2 Evidence of Buried Wastes

Operating Period. The time period over which the site was in operation can be used as an indicator of the magnitude of the waste problem. Sites with a long operating period will have generated more wastes and have a longer period of waste migration.

Excavation History. Excavation history is an important assessment factor in that it provides documentation as to the existence of buried wastes. The difficulty with this factor is that reporting of waste occurrence during past excavation is not consistent between sites. Sites with excavation and no reported wastes are of less concern than sites with no excavation which are in turn of less concern than sites where wastes were reported during excavation. The high criteria for this category is of additional concern in that excavation into sites containing wastes may have resulted in tank rupture and dispersal of wastes over a larger area.

Visible Wastes. This factor provides an assessment based on the visual inspection of wastes from site inspections conducted as part of this study and from historical accounts. Sites with large areas of visible waste such as tar or spent oxide box waste will present a greater hazard than those with no visible waste. Visible waste over a larger area will receive a high ranking.

Odour. Odours in the area of a site provides an indication of the presence and extent of wastes. With coal tar odours detectable in the ppb range, this method can provide a suitable site assessment method. Sites with distinct odours reported in the past or noticeable at present likely contain waste and are therefore of greatest concern.

Water Pollution. Presently visible or past reported surface water or groundwater pollution is an indication of an ongoing environmental impact and cause for concern. On-site ponded water that

is oily or discoloured may be confined to the site property and receives a medium ranking. If the surface water or groundwater pollution is documented to have drained or seeped in the past or is suspected to be seeping presently to a surface water body, then the impact is more serious and a high ranking is recorded.

3.3.2.3 Resource Characteristics

Surface Water Proximity. The proximity of a site to a surface water body represents an important factor in the assessment of a site. A short distance to a river or stream results in a short travel distance for a contaminant release and therefore is an important assessment criteria. Sites adjacent to a surface water receptor are of greatest concern, whereas sites at distances greater than 1 km are of least concern.

Surface Water Use. If the surface water adjacent to a site is impacted by gas plant wastes, it is important to consider the use of the water within the potentially impacted area. Industrial use is unlikely to be affected by poor water quality but recreational or, more significantly, drinking water use represents a serious impact. Surface water in the area of the site used for drinking water is therefore of greatest concern.

Groundwater Proximity. The ease with which groundwater may be impacted depends on the permeability of subsurface materials and the distance to the water table. Sites located on low permeability materials such as clay or shale bedrock are unlikely to have extensive areas of groundwater contamination and warrant a low ranking. If the site overlies a major aquifer and is directly connected, the potential exists for widespread migration of contaminants. In this case, sites would receive a high ranking. If the site is isolated from an aquifer by a confining layer, the aquifer has some measure of protection and receives a medium ranking.

Groundwater Use. Groundwater within the potentially impacted area that is used for public water supplies represents the most serious impact and therefore is of greatest concern and highest ranking. No groundwater use within the potentially impacted area is of least concern. A medium ranking is assigned to this factor if a few industrial or private wells situated within the expected impact area.

3.4 PHASE 4 - DEVELOPMENT OF OPTIONS FOR FURTHER ACTION

For each site identified from Phase 1 activities, options for further action are developed. These options are developed based on site access, site conditions, the nature and disposition of wastes, the potential environmental impact associated with the wastes and perceived needs for additional information. The options for further action range from notifying and cautioning municipalities and land owners of the likely existence of buried wastes at each site to implementation of site investigations with the intent of developing specific site remediation plans.

4. RESULTS

4.1 LIST OF MANUFACTURED GAS PLANT SITES

The study approach described in Section 3 has identified 41 manufactured gas plant sites ("town gas" plants) in 36 different communities in Ontario. The distribution of gas plants in Ontario is shown on Map 1. Table 4.1 presents a list of these sites with their location and approximate years of operation. The list in Table 4.1 has been revised slightly from the preliminary list of sites released by MOE on January 20, 1987. The preliminary list was prepared based on historical information only and included several sites that were later found to be solely industrial applications. These industrial sites are outside the terms of reference for this study but for the sake of completeness are addressed in Section 5.

Site specific information collected on each site listed in Table 4.1 is presented in the appendices contained in Volume II of this report. The information is arranged in a consistent manner for each site with each appendix containing the following:

- location map;
- historical gas plant map;
- fact sheet.

The location map identifies the location of the gas plant in the community on a small scale map. The historical map illustrates the configuration of the gas plant in its largest extent and locates the plant in relationship to existing streets. Other historical maps available for each site are listed on the fact sheets. Detailed information regarding property occupants is given on the fact sheets. The fact sheets, described in Section 3.3.1, contain the factual

Table 4.1 List of Manufactured Gas Plant Sites in Ontario

1840-1970

COMMUNITY	ADDRESS	APPROXIMATE YEARS OF OPERATION
Barrie	17-31 Kempenfelt Dr. between Sampson St. and Duckworth St.	1878-1939
Belleville	110-118 Church St. between St. Paul and Dundas St. E.	1854-1947
Brampton	Northeast corner of Nelson St. and George St.	1888-1917
Brantford	East Ave. bounded by Alfred, Newport, East and Colborne Sts.	1860-1911
Brockville	40 St. Paul St. bounded by St. Paul and King Sts. and Butlers Creek	1853-1957
Cambridge (Galt)	140 North Water St. bounded by Grand River and opposite Simcoe St.	1887-1911
Chatham	307 King St. W. bounded by Second St., King St. W., Third St. and Thames River	1873-1929
Cobourg	Between Queen and Charles Sts. west of McGill St. and east of Division St.	1857-1937
Cornwall	S.W. corner Water St. E and Amelia St.	1882-1929
Deseronto	South side of Main Street between First - Second St.	1886-1920
Dundas	43 Cootea Dr. on E. side of Thorpe and King St. E.	1863-1909

COMMUNITY	ADDRESS	APPROXIMATE YEARS OF OPERATION
Guelph	118-124 Fountain St., N.W. corner of Fountain & Wyndham Sts.	1871-1957
Hamilton	1. N. and S. of Mulberry St. between Bay North & Park North St.	1850-1925
	2. Hamilton By-Product Coke Ovens, Burlington-Industrial Depew St. area	1924-1958
Ingersoll	83 Avonlea St, N. end of Avonlea St. at railway tracks	1876-1915
Kingston	Bounding blocks, Place D'Armes Ontario, Queen, and Barrack Sts.	1848-1957
Kitchener	Gaukel St. bounded by Joseph and Charles Sts.	1882-1958
Lindsay	66 William St., S.E. corner of of William and Wellington Sts.	1881-1890
Listowel	46 Elma St. between Livingstone Ave. E. and Maitland River	1891-1915
London	Area bounded by Thames, Horton, Simcoe, Bathurst and Ridout Sts.	1853-1939
Napanee	96 Water St., S.W. corner of Water and West Sts.	1880-1921
Oshawa	1. West corner of Centre and Bond Sts.	1903 - before 1928
	2. 80 Emma St. at CN Railway Line (Old Prospect St.)	1901-1954
Ottawa	1. S.W. corner of York and King Edward Sts.	1854-1915
	2. 175 Lees Ave.	1920-1957
Owen Sound	1141-1145 First Ave. E.	1888-1947

COMMUNITY	ADDRESS	APPROXIMATE YEARS OF OPERATION
Peterborough	N. side of Simcoe St. between Queen St. and Railway Line, adjacent to Otonabee River	1869-1950
Port Hope	70-80 John St., W. side of John St. between Park and Alexander Sts.	1859-1938
Port Stanley	Carlow Road bounded by Merr Rd., Carlow Rd, Lake Rd, and George Street	1945-1958
St. Catharines	S. of Gale Crescent, bottom of Calvin St., beside Old Welland Canal	1853-1928
St. Thomas	Corner of Mondamin and Gas Sts.	1877-1935
Sarnia	Maxwell St. bounded by Maxwell, Water, Front Sts. and Railway tracks	1884-1909
Sault Ste. Marie	Goulais Ave. bounded by Bonney, Baseline, Pittsburgh and Goulais Sts.	1925-1963
Simcoe	S.E. corner of Pond and Water Sts.	1891-1910
Stratford	Wellington St., bounded by St. Patrick, Nelson, St. David and Erie Sts.	1879-1953
Toronto	1. Station A, 271 Front Street area of Princess, Berkeley, Front, Parliament and Trinity Sts.	1841-1954
	2. 415 Eastern Ave., N.E. corner of Booth St. and Eastern Ave.	1909-1954
	3. 28 Bathurst St., N.W. corner of Bathurst St. and Front St. W.	1909-1954
Waterloo	E. side of Regina St. and W. side of William St., S. of Laurel Creek	1889-1957

COMMUNITY	ADDRESS	APPROXIMATE YEARS OF OPERATION
-----------	---------	-----------------------------------

Windsor	S. of McDougall Ave. opposite the S.W. extension of Brant St.	1871-1930
Woodstock	Young St. bounded by Young, Peel, Burtch Sts. and an open area	1876-1919

information on each site. Most of the information collected on each site has been condensed onto the fact sheet in order to provide as complete a description of each site as is possible.

4.2 PRELIMINARY ASSESSMENT OF POTENTIAL ENVIRONMENTAL IMPACTS OF MANUFACTURED GAS PLANTS

An assessment of the potential environmental impacts of each site listed in Table 4.1 was completed using the assessment criteria described in Section 3.3.2 and Table 3.1. The results of the preliminary assessment are given in Table 4.2 using high (H), medium (M) and low (L) rankings under each factor. The information necessary to complete the assessment of each site is found on the fact sheets. As was stated in Section 3.3.2, the preliminary assessment is qualitative and reflects the variable, uncertain and conjectural nature of some of the site specific information. The exercise is most useful in identifying categories (site characteristics, evidence of buried wastes and resource characteristics) or factors for each site that may indicate a potential environmental impact and to provide a broad overview of each site.

In completing the assessment, the factors concerning visible wastes, odours or water pollution required clarification as to whether the problems were existing or historical occurrences. The distinction is important in terms of the environmental impact because it indicates a present problem or a problem that may have been more significant in the past. Historical occurrences, however, are just as important as present occurrences in terms of potential environmental impacts in that they may indicate the presence of on-site or off-site wastes, past or future impacted areas or migration pathways.

The following section provides a site by site description of each gas plant and identifies and describes the important assessment factors for each site.

Table 4.2 Assessment of Potential Environmental Impacts of Manufactured Gas Plant Sites in Ontario

Site Characteristics				Evidence of Buried Wastes				Resource Characteristics					
Site Name & Location	Size	Location	Current Use/Ownership	Planned Use/Ownership	Potential for Excavation	Operating Period	Excavation History	Visible Waste	Odour	Water Pollution	Surface Water Proximity	Ground-water Proximity	Ground-water Use
Barris	L	H	H	H	H	H	H	H ^h	H ^h	L	H	M	M
Belleville	M	H	M	M	M	M	M	H ^h	H ^h	H ^h	M	M	L
Brampton	L	M	M	L	L	L	L	L	L	L	M	L	L
Brantford	M	H	M	L	L	M	L	L	e ^p	e ^p	M	L	L
Brockville	M	H	M	L	L	M	L	L	L	L	M	L	L
Cambridge	L	M	M	H	H	L	L	L	L	L	M	L	L
(Galt)													
Chatham	H	H	M	L	L	M	M	H ^h	L	L	M	L	L
Cobourg	L	H	M	L	L	M	L	L	L	L	M	L	L
Corwall	L	H	H	L	M	M	L	L	L	L	M	L	L
Deseronto	L	H	H	H	H	M	H	H ^h	H ^h	L	M	L	L
Dundas	L	M	M	L	M	M	M	L	L	L	M	L	L
Guelph	H	H	H	L	M	M	H	H ^h	L	L	M	L	L
Hamilton (Deepen-Burlington area)	M	M	L	L	L	M	M	e ^p	e ^p	e ^p	H	L	L
Hamilton													
(Mulberry)	H	H	M	L	M	H	L	L	L	L	M	L	L
Ingersoll	L	H	L	L	L	M	M	L	L	L	M	M	M
Kitchener	H	H	H	L	L	H	H	H ^h	L	L	M	L	L
Kitchener	H	H	H	H	H	M	M	H ^h	L	H ^h	M	M	L
Lindsay	L	H	M	L	L	L	M	L	L	L	M	M	L
Listowel	L	M	M	L	L	L	M	L	L	L	M	M	M
London	H	H	H	L	M	H	H	H ^h	L	H ^h	H	M	L

• Positive identification, however wastes may not be solely attributable to former gas plant as a result of other industrial activities within the area.
h evidence from historical reference
p evidence from observation during the course of this study

Table 4.2 Assessment of Potential Environmental Impacts of Manufactured Gas Plant Sites in Ontario

Site Name & Location	Site Characteristics			Evidence of Buried Wastes					Resource Characteristics					
	Size	Location	Current Use/Ownership	Planned Use/Ownership	Potential for Excavation	Operating Period	Excavation History	Visible Waste	Odour	Water Pollution	Surface Water Proximity	Surface Water Use	Ground-water Proximity	Ground-water Use
Nipawee	L	H	H	L	H	M	L	L	L	L	H	M	L	L
Oshawa (Bond)	L	M	M	L	L	L	L	L	L	L	M	M	L	L
Oshawa (Ems)	M	H	L	L	L	M	M	H ^h	L	L	M	M	L	L
Ottawa														
(King Ed.)	H	H	M	L	M	M	H	H ^p	H ^p	H ^p	L	M	L	L
Ottawa (Lees)	H	H	H	L	M	M	M	H ^p	H ^p	H ^p	M	M	M	L
Owen Sound	M	H	M	L	L	M	M	H ^h	L	L	H	M	L	L
Peterborough	H	H	M	L	M	M	M	H ^h	H ^p	H ^h	M	M	L	L
Port Hope	L	H	M	L	M	M	M	L	M	L	M	H	M	L
Port Stanley	H	M	M	M	M	L	M	H ^p	H ^p	L	H	M	L	L
St. Catharines	H	H	M	M	L	M	M	L	L	L	M	L	L	L
St. Thomas	H	H	M	L	M	M	M	H ^h	L	L	M	M	L	L
Sarnia	M	H	L	H	M	M	M	L	L	L	H	M	M	L
Sault														
Ste. Marie	M	M	L	L	L	M	M	L	L	L	M	M	L	L
Simcoe	L	H	H	L	L	L	M	L	H ^h	L	H	M	L	L
Stratford	M	H	M	L	L	M	M	L	L	L	M	M	M	M
Toronto "A"	H	H	H	H	M	H	H	H ^p	H ^p	H ^h	M	M	L	L
Toronto "B"	H	H	H	L	L	M	M	H ^h	L	L	M	H	L	L
Toronto "C"	H	H	L	L	L	M	M	L	L	L	M	M	L	L
Waterloo	M	H	H	L	M	M	M	H ^p	H ^p	H ^p	M	M	M	M
Windsor	M	H	H	L	M	M	M	H ^h	H ^p	L	M	M	L	L
Woodstock	L	H	M	H	H	M	H	H ^p	H ^p	H ^p	M	M	L	M

4.3 DESCRIPTIONS OF MANUFACTURED GAS PLANTS IN ONTARIO

This section contains site descriptions, an assessment of the potential environmental impact, and options for further actions for each manufactured gas plant in Ontario. The site descriptions should be read in conjunction with the detailed site information contained in the appendices.

4.3.1 Barrie

Site Description

In Barrie, manufactured gas was produced by the Barrie Gas Co. from 1878 until 1928 when it was taken over by the Town of Barrie and operated until 1939. The plant was initially a coal carbonization plant until 1890 when it was converted to a water gas plant. It was a small site of about 0.3 ha in area located adjacent to Kempenfelt Bay on Kempenfelt Street between Sampson and Duckworth Streets.

The gas plant property is presently a vacant lot scheduled for condominium development. A major portion of the property was excavated in 1985 to a depth of about 4.5 m in preparation for construction. The adjacent land use consists of single family homes to the north, west and east with a Canadian National railway line and Kempenfelt Bay to the south.

Potential Environmental Impact

During excavation of the site in 1985 contaminated soil was encountered and removed to a clean fill area (Lot 8, Concession 1, Vespra Township) at Highways 11 and 400 and to the Barrie landfill. The contaminated material was found within and outside of the bases of two gas holding tanks. No free coal tar wastes were encountered during excavation. Local citizens reported objectionable odours off-site

to MOE during the excavation of the site. Soil and water samples collected on-site by MOE indicated the presence of PAH consistent with coal tar contamination.

The excavation conducted in 1985 encountered contaminated soil in and around the two gas storage tanks. On the basis of this information, it appears that the site does not contain waste on-site and the site presents a low environmental hazard. However, it is not known if all of the contaminated soil has been removed and if some of this soil remains, it may be a source of contaminated water that could discharge to Kempenfelt Bay. The likelihood of contaminated groundwater migrating towards the City of Barrie municipal well (Bayview #2) approximately 300 m west of the site is considered remote.

The city of Barrie has agreed not to issue a building permit for the site until the owner of the gas plant property has demonstrated that no contaminated material remains on the property.

The clean fill area located at Highways 11 and 400 received excavated material and may also result in potential health effects or environmental impact. MOE is presently studying the environmental impacts of this disposal area. The gas plant property owner has been requested by MOE to remove the contaminated fill.

Options for Further Action

For the Barrie site, the following are considered appropriate options for further action:

- Water quality monitoring for general water quality and PAH compounds in the nearest water supply wells (Bayview #2);
- Sediment sampling from the shore of Kempenfelt Bay and analysis for PAH compounds;

- Sampling of soils on-site and visual inspection for gas plant wastes;
- Installation of monitoring wells and sampling of shallow groundwaters to assess potential contaminant discharges to Kempenfelt Bay.

The gas plant property owner has hired a consultant and they will be instructed by the Ministry of the Environment to consider the above options as part of their proposal for work.

The MOE is presently studying the waste disposal area located at Highway 11 and 400 and options for future action at the disposal location will depend on the results of their studies.

4.3.2 Belleville

Site Description

The Belleville gas plant was located at 110-118 Church Street bounded by Church, St. Paul (formerly Wharf Street) Pinnacle and Dundas Streets. The plant was operated by the Belleville Gas Co. from 1854 to 1930, the Ontario Shore Gas Co. from 1930 to 1935 and the Belleville Public Utilities Commission from 1937 to 1947 for a total operating period of 93 years. The gas plant property was about 0.7 ha in area including land fronting on both Church Street and Pinnacle Street.

Presently, the eastern portion of the gas plant property adjacent to Church Street is a vacant lot. The gas facilities were located on this property. The development plans for this lot are unknown but a "for-sale" sign is posted. The western portion of the property adjacent to Pinnacle Street is occupied by the Hawkins Cheezle Factory. Adjacent property consists of commercial land use (Thompson Farm Supplies for example) to the north and east and residential land use (single family homes) to the south and west.

Potential Environmental Impact

The Belleville gas plant has resulted in several instances of off-site migration of waste as documented in files of MOE's Belleville District Office. In June 1981, an excavation for a sanitary sewer along Pinnacle Street west of the gas plant site encountered tar. The excavation was approximately 4.5 m below surface into limestone bedrock and a small amount of coal tar was found seeping into the excavation from several localized areas in the bedrock. Contaminated groundwater from the excavation was initially pumped into a storm sewer which discharged into a public boat launch area on the Moira River near St. Paul Street creating an oil slick on the river. Subsequently, the oily water from the excavation was diverted to a sanitary sewer and the local sewage treatment plant.

In May 1983, storm sewer construction at the intersection of Front Street and St. Paul again encountered traces of coal tar. The excavation was initially kept dry by pumping into the storm drainage and when coal tar seepage was encountered the seepage was directed to a sanitary sewer.

These occurrences of waste indicate off-site migration of coal tar. The evidence of tar (stained rock) in an excavation immediately adjacent to the river indicates a high probability of past direct discharge of coal tar to the Moira River. The Moira River also discharges to the Bay of Quinte.

In terms of environmental impacts, groundwater contamination is likely occurring and it is also likely that the Moira River is receiving some of this contaminated groundwater. Some of this contaminated groundwater coming off the gas plant property may be intercepted by the sewer trenches, thus reducing in the long term contaminated groundwater discharge to the River.

Additional impacts may occur if the gas plant property is developed without proper precautions taken to protect worker safety.

Options for Further Action

For the Belleville site, the following are considered appropriate options for further actions:

- Notify and caution property owners and municipality that buried gas plant wastes may be found on-site:

- A detailed study of the site and surrounding area should be undertaken and should include the following:
 - Sediment sampling of the shore of the Moira River in the area of the gas plant and analysis for PAH contaminants;
 - Soil gas sampling or soil and bedrock sampling in the area between the gas plant and the river to determine the extent of off-site contamination and its proximity to the river;
 - Installation of monitoring wells and sampling of shallow groundwaters in the area between the gas plant and the river to assess potential contaminant discharges to the river.
 - If extensive off-site contamination is discovered or if the gas plant property is to be developed on-site studies such as geophysical surveys, soil gas sampling, soil surveys and groundwater monitoring are required to define sources of buried wastes.

4.3.3 Brampton

Site Description

The Brampton gas works was a small manufactured gas plant that operated for less than thirty years at the northeast corner of Nelson and George Streets in the old town of Brampton. The plant was likely a coal carbonization facility which was initially operated by Brampton Gas Co. (1888-1902) and later (1903-1917) by the Equitable Gas Co. Ltd. The layout of the plant is shown on a 1917 fire insurance plan from the Regional Collection of the University of Western Ontario.

The site is now occupied by a two-storey commercial office building with basement that was constructed in 1957. Adjoining property uses include a City of Brampton parking lot located north of the site; a series of commercial land uses including federal government buildings; Brampton Mid Centre Mall; auto sales and apartments. No groundwater use is reported in this area and the closest surface water bodies are Etobicoke Creek and Fletcher's Creek located approximately 300 m east and west, respectively, of the site.

Potential Environmental Impact

No significant environmental impact or adverse health effect is perceived for this site. The small plant size (only a 56 m³ capacity gas holding tank is evident on the 1917 fire insurance plan) and short operating period suggests that a relatively small volume of waste products were likely produced. It is reported by the property owner that during the excavation for construction of the building (1957) no tars or oily sludges were encountered in the subsurface. Recent inspections of some of the basements in this building showed no visible or olfactory evidence of gas plant wastes. Also during 1986, the City of Brampton excavated about 1.5 m of fill from the former

coal yards located immediately north of the plant and did not observe any oily wastes or odours. Inspections of the basements in the buildings of the surrounding properties also showed no evidence of seepage or odours.

Options for Further Action

For the Brampton site, the following are considered appropriate options for further actions:

- No future actions are required at this site other than notifying the present owner and the municipality that buried gas plant waste may be found on-site.

4.3.4 Brantford

Site Description

The Brantford gas works began operation in the late 1850s or early 1860s and continued until about 1911. The plant was located on the north and south sides of East Avenue between Alfred and Newport Streets and was operated by the Brantford Gas Co. Its operation may have been intermittent. The plant may also have been converted to natural gas distribution after 1911 and operated by the Dominion Gas Co.

Presently the gas plant property is occupied by the Union Gas Co. who operate a warehouse/stock room and parking lot on the property south of East Avenue and an office and parking lot on the property north of East Avenue. Access to the warehouse property is controlled by a fence and gate. Adjacent property consists of commercial and residential properties to the north, commercial to the west, residential to the east and parkland to the south. On the western border of the property, south of East Avenue, is a small gabion-lined creek that receives its water from a storm sewer. The parkland to the south was previously a canal basin that was reclaimed in the early 1950's.

Potential Environmental Impact

The Brantford gas plant has had no reported problems resulting from buried wastes. The site reconnaissance visit identified petroleum-like odours coming off the creek and a small oil slick emanating from the storm sewer. It is not known whether or not these pollutant problems are caused by the former gas plant, result from road runoff or an upstream discharge. Similar odours were found coming from a drainage pipe that discharges into the east side of the creek just south of East Avenue. The pipe appears to act as a storm drain for the Union Gas parking lot and, at the time of the site visit, was discharging at about 20 Lpm.

Environmental impacts from this site are likely to be small or negligible primarily because the property has not been disturbed by excavation and access to the site is controlled. The most likely environmental impact might be groundwater discharge of contaminated material to the creek.

Options for Further Action

For the Brantford site, the following are considered appropriate options for further actions:

- Notify present property owners and municipality that buried gas plant wastes may be found on-site;
- Sediment and water sampling of the creek is required in order to assess the petroleum odour and oil slick in the creek and its general water quality.

4.3.5 Brockville

Site Description

The Brockville Gas Company, was located on the west side of St. Paul Street between King Street West and Butler Creek and was in operation for about 104 years from 1853 to 1957. After 1921, the gas plant was operated by the Brockville Public Utilities Commission. The gas plant was of medium size, occupying about 0.5 ha and was probably a coal carbonization plant initially, but was likely converted to water gas in the early 1900's.

The former gas plant property is now occupied by a City of Brockville parking lot for the adjacent Arts Centre Theatre and IGA supermarket. Commercial buildings are located to the north, west and east with residential areas located to the east and south. Butler Creek which flows to the St. Lawrence River lies immediately to the south of the former site. The parking lot is paved and effectively covers and drains the site.

Potential Environmental Impact

The Brockville gas works has had no reported environmental problems and the site inspection, although hindered by winter conditions, did not detect odours or visible contamination. Shallow excavation into the site in 1985 for the city parking lot did not reportedly encounter waste materials. A 1200 mm diameter sanitary trunk sewer also extends through the site with no reported problems.

Although there are no apparent environmental problems associated with the site, the years of plant operation are long, (104 years) increasing the likelihood of having produced a large amount of waste. The site has been excavated (sewer construction) which may

have disturbed any existing waste containment structures. There is also no information to indicate that waste facilities were removed from the property. The adjacent creek is likely to be the receptor for any contaminant releases to the environment. At present, storm catch basins for the parking lot drain into the creek from the creek bank. In addition, the creek is at an elevation approximately 5 m below the parking lot surface creating a significant gradient for coal tar migration.

Options for Further Action

For the Brockville site, the following are considered to be appropriate options for further actions:

- Notify present property owners and municipality that buried gas plant wastes may be found on-site;
- Sediment sampling of Butler creek adjacent to the former gas plant and analysis for PAH contaminants.

4.3.6 Cambridge (Galt)

Site Description

The Galt gas plant was located at 140 North Water Street bounded by Lavins and Simcoe Streets and the Grand River in what is now part of the City of Cambridge. The plant was operated by the Galt Gas Light Co. from about 1887 to about 1911. In the 1920's the plant was probably demolished and an extension to the adjacent textile mill was built on the property.

Today, the property is vacant with construction of condominiums planned for the property in the spring of 1987. The foundations and some of the walls from the former textile mill still remain on-site. Adjacent land use consists of commercial properties to the north, east and south of the property. The Grand River is located to the west and this area is recreational parkland.

Potential Environmental Impact

The most significant problem associated with the former Galt gas works is that the site is to be excavated for the construction of condominiums in the spring of 1987. While there has been no previously reported indications of gas plant wastes in the area, it is possible that waste may have remained on-site. If wastes were encountered during excavation of the site, the most likely health effects or environmental impacts would result from dermal contact with or vapour inhalation of waste materials and the possibility of waste migration to the Grand River.

The gas plant was likely demolished in the 1920's and it is possible that waste facilities (holding tanks, tar wells) were removed at this time. Foundations from the textile mill (demolished in 1985) remain on-site and extend about 3 m below surface indicating a deep

excavation for the mill construction. The depth of soil on-site is reported to be thin (less than 1.0 m) and it is conceivable that the foundations were set on bedrock. If this was the case, very little waste material may remain on-site.

Options for Further Action

For the Cambridge (Galt) site, the following are considered appropriate options for further actions:

- Notify present property owners and municipality that buried gas plant wastes may be found on-site;
- Soil sampling of the area in conjunction with geotechnical investigations for construction should be completed prior to excavation to determine whether or not waste material is found on-site.

4.3.7 Chatham

Site Description

The Chatham gas plant, located at 307 King Street West and bounded by Second and Third Streets and the Thames River, was in operation from 1873 to about 1929. The gas plant probably produced retort gas for most of its history and was operated by the Chatham Gas Company Ltd.

The gas plant property is now occupied by the Chatham Civic Centre which contains the administration and various departments of the City of Chatham. The Civic Centre was constructed in 1975 and has below ground parking. Adjacent property consists of the Thames River to the north, the YMCA to the west, single family homes and a city parking lot to the south and residences and commercial buildings to the east. The bank of the Thames River has a steel retaining wall along its bank and the area is landscaped as a recreational area.

Potential Environmental Impact

During construction of the Civic Centre in 1975, former gas plant structures were encountered. These structures included the foundation of a gas holding tank (18 m diameter), a tar tank, a tar well (4.3 m diameter), and building foundations. The gas holding tank contained rubble and oily water and the well contained an oily, asphaltic material. These structures were reported to be removed by the building contractor while excavating for foundation footings. The disposal of the excavated material was the responsibility of the building contractor and no city record exists of the disposal location. The volume of excavated material or its chemical composition is also not known nor is it apparent whether or not all contaminated material was removed.

In terms of environmental impact, the most likely occurrence is via contaminated seepage into the Civic Center basement or seepage to the Thames River. The Civic Centre below ground parking lot is underdrained by catch basins which drain to the building sumps. The foundation drains also drain to the building sump which in turn discharges via a storm sewer to the Thames River through the steel retaining wall. During the site reconnaissance visit, the Civic Centre's sump and storm drains were inspected and no evidence of contaminated seepage or odours were detected. There were also no reported occurrences of odours in the basement.

Direct seepage of contaminated material to the Thames River is likely to be retarded by the steel retaining wall. The wall extends along the river for the length of the former gas plant property and is tied into clayey material at its base. The retaining wall, depending on its construction, may act as a containment structure to prevent seepage of contaminated material to the river.

Options for Further Action

For the Chatham site, the following are considered appropriate options for further actions:

- Notify present property owners and municipality that buried gas plant wastes may be found on-site;
- Water sampling of the Civic Centre building storm drain which discharges to the Thames River and analysis of samples for PAH compounds;
- Sediment sampling of the Thames River in the area of the retaining wall (especially the ends of the wall) and the storm drain outfall.

4.3.8 Cobourg

Site Description

The Cobourg gas works was a small coal gasification plant that operated for about 80 years between 1857 and 1937 by various utilities including Cobourg Gas Works, Cobourg Gas, Light and Water Co., Cobourg Utilities Corporation and the Hydro Electric Power Commission of Ontario. The site is situated between Queen and Charles Streets west of McGill Street. The former gas works property is now occupied by the Cobourg Post Office building and parking lot and a parking lot associated with the Northumberland Professional Building. The property of most of the former gas works facilities including a 560 m³ gas holder and the gas purifying facilities are now occupied by the fenced-in parking lot of Canada Post Corporation. The site is located within a residential public use area with parkland to the east, Cobourg Centennial Pool and residences to the south and a parking lot, garage and dry cleaners to the north.

Potential Environmental Impact

Soil borings undertaken for sewer construction and construction of the Cobourg Centennial Pool both of which are located south of the site and Charles Street showed no evidence of tars or spent oxide waste, although some cinders and ash were observed in the near surface. Gas plant wastes were also not reported during construction of the Post Office building in 1952 and later during expansion in 1970. Basement sumps of both the Post Office and the Professional Building were observed to be clean of gas plant wastes.

Although the site is located within a residential public use area, the lack of evidence of buried wastes indicates no immediate health hazard and minimal potential environmental impact.

Continued use of the majority of the site as a parking lot and the low potential for redevelopment and excavation contributes to the low assessment of potential environmental impact.

Options for Further Action

For the Cobourg site, the following are considered appropriate options for further actions:

- No further actions are required at this site other than notifying the present owners and municipalities that buried gas plant wastes may be found on-site.

4.3.9 Cornwall

Site Description

The Cornwall Gas Works was a small manufactured gas plant located on the north side of Water Street between Amelia and Adolphus Streets. The plant was operated by the Cornwall Gas and Light Co. from 1882 to 1895 and then by the Stormont Electric Light and Power Co. from 1895 to 1929 for a total operating period of 47 years. The gas producing process was most likely a water gas procedure, at least in its later stages.

At present, the former gas plant property is occupied by residential row houses and a semi-detached home. Adjacent properties consist of the Cornwall Curling Club to the north, a federal government building to the west, an arena and a parking lot to the east and a vacant property to the south.

Potential Environmental Impact

This site has had no reported environmental problems even though there has been considerable construction and excavation in the area. One of the homes has a basement which is dry with no reported odours. A 760 mm diameter sanitary trunk sewer runs through the middle of the site and it was apparently installed without problems. In recent years, there has been considerable construction including road and sewer excavation along Water Street in the area of the former gas plant. City workers have not reported any evidence of odours or waste material during this work.

Based on the reported information, the former gas plant site is unlikely to create an environmental impact.

Options for Further Action

For the Cornwall site, the following are considered appropriate options for further actions:

- No further actions are required at this site other than notifying the present owners and municipalities that buried gas plant wastes may be found on-site.

4.3.10 Deseronto

Site Description

The Deseronto gas works, located south of Main Street between First and Second Streets, were in operation from about 1886 to about 1920. The gas plant was associated with a chemical manufacturing operation that produced wood alcohol and by-products. The chemical works also included a number of charcoal burners that were immediately west of the gas works. Early maps (1898) of the area indicate a tar distillation room and a retort room that were part of the chemical works but the exact use of these facilities is unknown. It is likely that a tar-based wood preservative (e.g., creosote) may have been produced.

The chemical plant was located on the shore of the Bay of Quinte with the gas works immediately to the north. Today, the property is occupied by Hawley Bros. Ltd. which operate a furniture manufacturing business. A single family home in addition to two factory buildings are found on-site. The outline of the gas holding tank is still visible on the property. The property has been severed in order to build another house on the property.

Potential Environmental Impact

Potential environmental impacts from the former gas plant are most likely to occur due to the proposed building of an additional home on the property. Excavation on the property could intersect waste materials remaining on-site. The potential for buried wastes on-site is evidenced by several historical occurrences. During construction of the Hawley family home in 1951, it was necessary to let the foundation excavation stand open for about one month to vent gases from the soil.

The excavation was about 1.2 to 1.5 m below the surface and about 0.6 to 1.0 m into bedrock. The location of the house is about the same location as the former gas plant buildings. During the site visits, the house basement was inspected and was found to be free of odours with a sump that contained clean, odourless water.

Another possible indication of waste on-site is the presence of the gas holding tank. Apparently in 1949, the foundation of the tank was filled in. It is possible that coal tar waste may remain at the base of the foundation.

The most likely cause of health effects or environmental impacts caused by excavation into waste material is from dermal contact and vapour inhalation or from the release and contaminant migration of either coal tar or contaminated groundwater to the Bay of Quinte. It should be noted, however, that because the gas plant was closed in the 1920's and the chemical plant closed in the late 1800s, most of the significant environmental impacts may have occurred in the past.

Options for Further Action

For the Deseronto site, the following are considered appropriate options for further actions:

- Notify property owners and municipality that buried gas plant wastes may be found on-site;
- Soil sampling should be completed in the area of the proposed building prior to construction and the samples inspected for indications of gas plant wastes. If wastes are suspected samples should be subjected to analysis for PAH compounds.

4.3.11 Dundas

Site Description

The Dundas Gas Light Co. operated a small town gas facility on the east side of Thorpe Street between King St. East and Cootes Drive from 1863 to about 1909. The plant was then turned over to Dominion Gas Co. who brought gas in from Brantford. In 1922-23, the ownership of the property transferred to the Wentworth Gas Co. After 1909, it is unlikely that the gas plant produced manufactured gas but was probably a distribution facility possibly first for gas produced in Brantford then for a natural gas source.

Today, one of the original gas plant buildings with its chimney is still standing on-site and is occupied by a small manufacturing business. Other land use in the area consists of commercial and residential use to the north, west and east and commercial use to the south.

Potential Environmental Impact

The only evidence of waste material identified at the Dundas site results from an excavation for a strip plaza in 1986 on adjacent property to the east. At this time, a small brick enclosure 1.8 x 1.8 x 1.8 m full of cinders and ash was encountered. There was no reported evidence of tarry material or odours. A 15 cm steel pipe leading to the gas works was also encountered in the excavation. Excavated material was taken to D. Hammond's property on Sulphur Springs Road. This situation will be investigated by the Ministry of the Environment.

An inspection of the original gas plant building did not detect odours or waste on-site and the building occupants did not report any problems that may have resulted from the gas plant. The location of the gas holding tank is now a small paved parking lot with installed storm drains. Odours were not detected in these drains.

Based on the information collected and the site visit, this site is unlikely to cause a significant environmental impact. Because the plant was in operation only for a short period and prior to 1909 environmental impacts if they occurred would have been more significant in the past than today.

Options for Further Action

For the Dundas site, the following are considered appropriate options for further actions:

- No further actions are required at this site other than notifying the present owners and municipalities that buried gas plant wastes may be found on-site.

4.3.12 Guelph

Site Description

The Guelph gas works was located on Fountain Street (formerly Waterloo Street East) between Huskisson, Surrey and Gordon Streets. The Guelph Gas Company operated the facilities from 1871 to 1903 at which time it was taken over by the Guelph Light and Heat Commission and operated until about 1957. Late in its history, the gas plant was owned and operated by the Union Gas Company.

The manufactured gas process was most likely a water gas operation as early as 1897. The Guelph gas works was a large facility which at its peak included three gas holding tanks and covered an area of about 1 ha.

Today, the majority of the site is owned by the City of Guelph which operates a parking lot on-site. A southwestern portion of the property, owned by the Union Gas Company is used as a service yard and office. The Union Gas property is fenced with controlled access while the City parking lot is uncontrolled and open to the public. Surrounding land use includes institutional (police station, government building, court house) use to the north and east, and residential and commercial use to the west and south.

Potential Environmental Impact

The Guelph gas works was a large facility in operation for a long period of time (86 years). Consequently, the potential for large amounts of waste is high. In addition, there was an on-site occurrence of waste material in the soils. During the installation of fence posts around the site, sand contaminated with tar was discovered within 1 m of ground surface. From this information, it is apparent that soil contaminated with tarry material is at the site boundaries and may also

be found off-site. The site topography is sloped towards the south and off-site migration of waste, if present, is most likely to occur at the southern boundary. Another important consideration is the fact that the site is a parking lot in the downtown area and is likely to be developed in the future. The site is presently paved and storm water catch basins will reduce to some extent the infiltration of precipitation to the waste materials.

Present environmental impacts from this site are not readily apparent except for possible off-site migration. If off-site migration is occurring then environmental impact may result in tar or contaminated seepage to the basements of residences to the south.

Options for Further Action

For the Guelph site, the following are considered appropriate options for further actions:

- Notifying property owners and municipality that buried gas plant wastes may be found on-site;
- Soil sampling and visual inspection of samples at the boundaries of the property to confirm the presence of on-site waste material;
- If waste material is found on-site at the boundaries then soil sampling is required off-site in a down-gradient direction.

4.3.13 Hamilton Industrial - Depew Street

Site Description

The Hamilton By-Product Coke Ovens were operated by the United Gas and Fuel Co. of Hamilton Ltd. for about 34 years from 1924 to 1958. The plant manufactured gas for distribution to the City of Hamilton. The plant was a very large facility (7-8 hectare) located mostly northeast of Industrial Drive and Depew Street adjacent to Hamilton harbour (Gages Inlet). A very large 141,500 m³ capacity gas holding tank was constructed in 1921 on what is now the northeast corner of Depew Street and Industrial Drive.

In 1942, the Department of Munitions and Supply for the Dominion of Canada expropriated Proctor and Gamble Inc. property situated southeast of Depew Street and Industrial Drive for the construction of additional gas manufacturing plants to service the Hamilton industries engaged in production of war materials. Fifty-four coke ovens were operational in this location between 1942 and 1947. In 1947, the coke ovens were dismantled and the property excavated to a level of 0.40 m below ground and returned to Proctor and Gamble Inc. In the late 1950's, early 1960's Proctor and Gamble constructed a warehouse on this site.

About 1958, the production of manufactured gas from the Hamilton By-Product Coke Ovens for city use was discontinued and the facility was acquired by the Steel Company of Canada Ltd. Stelco now operate a storage area on this site as part of the Hilton Steel Works. Both the Proctor and Gamble Inc. and Stelco properties have controlled access. The former Hamilton By-Product Coke Ovens site is now located within a heavy industrial area, adjacent to Hamilton harbour. Hamilton harbour has a history of contamination problems.

Potential Environmental Impact

Evidence of possible contamination was observed in the Ottawa Street slip adjacent to the original site of the Hamilton By-Product Coke Ovens. In particular, oily and discoloured soil and water were observed on the banks of and in the slip. Distinct hydrocarbon odours were also noticed in the area of this site. However, it is not clear that the observed contaminants are linked to the former manufactured gas plant.

The potential environmental impact of this site is mitigated by the industrial land use, continued ownership, low potential for excavation and limited water use in the area.

Options for Further Action

The Hamilton By-Product Coke Oven site must be considered as a special case in the determination of options for further actions. This site is a heavy industrial area and may have environmental concerns in addition to those that may be caused by the former gas plant. With past contamination in Hamilton harbour from sources other than the former gas plant it is not feasible nor practical to suggest further action to investigate solely the former gas plant.

4.3.14 Hamilton - Mulberry Street

Site Description

The Hamilton - Mulberry Street gas works was a large retort coal gasification plant that operated from about the 1850s to the mid 1920s. The exact starting and closing dates of plant operation are uncertain, but it is likely that the plant did not operate simultaneously with the Hamilton By-Product Coke Ovens which were constructed in the early 1920s. Both of these facilities were operated by the United Gas and Fuel Co. of Hamilton. The Mulberry Street plant was operated earlier under the name of the Hamilton Gas Light Co.

The plant was mostly located on the south side of Mulberry Street between Bay Street North and Park Street North. A large 7,075 m³ capacity gas holding tank was located on the north side of Mulberry Street across from the main plant site.

The former gas works property is now located in a mixed residential-commercial, light industrial use area. The main plant site is now occupied by a Bell Canada office, garage and storage area, and scrapyard of Canadian Iron and Metal Co. The site of the former gas holding tank situated north of Mulberry Street is now a building and parking lot of the Hamilton-Wentworth Separate School Board. Access to all of these properties is controlled by fences and gates. Burlington Bay is the closest surface water body and is located about 600 m north of the site.

Potential Environmental Impact

Although the Hamilton-Mulberry Street gas works was a large site that operated for a long period of time, and is now located in a residential-commercial area, current site land use, lack of evidence of buried wastes and, controlled site access combine to indicate a low

ranking with respect to potential environmental impact. On-site inspections revealed no visible or olfactory evidence of wastes both at surface and in basement sumps. The basements and sumps of the separate school board building and the Bell Canada building were inspected and observed to be free of gas plant wastes. The lack of groundwater use and the distance (600 m) to the nearest surface water body (Burlington Bay) further contribute to an assessment of low potential environmental impact.

Options for Further Action

For the Hamilton-Mulberry site, the following are considered appropriate options for further actions:

- No further actions are required at this site other than notifying the present owners and municipalities that buried gas plant wastes may be found on-site.

4.3.15 Ingersoll

Site Description

The Ingersoll gas works was a small facility located on the northeast end of Avonlea Street (formerly Gas Street) at the Canadian Pacific Railway. The gas plant was operated by the Ingersoll Gas Light Company from 1876 to 1915. By 1932, the property belonged to the Dominion Natural Gas Company and was likely used for storage or as a distribution system for natural gas.

Presently, the former gas plant site is occupied by a commercial plumbing operation. Most of the former gas plant property is contained within a fenced compound. A small building, on-site, may be an original gas plant structure otherwise there is no other evidence of the former gas plant. Adjacent land use consists of railway land to the north, residential land use to the west and commercial use to the south and east.

Potential Environmental Impact

The Ingersoll gas plant has had one reported on-site odour problem. A gas odour was reported in the remaining gas building but was removed after a pipe in the floor was plugged. No other odours or wastes have been identified on-site.

In terms of potential environmental impacts the most significant receptors are municipal water supply wells. The nearest well is about 800 m away on Merritt Street between Ann and Francis Streets; however, the well is about 120 m deep with a 30 m casing installed into the top of the limestone bedrock. Based on these construction details, the possibility of this well becoming contaminated from groundwater emanating from the gas plant site is considered remote. Recent sampling of water from this well by the MOE indicates no contamination.

The nearest surface water body is the Thames River located about 100 m to the northwest. Although there has been no indication of off-site migration, the river is the most likely receptor should contaminated water discharge at surface.

Options for Further Action

For the Ingersoll site, the following are considered appropriate options for further actions:

- Notifying property owners and municipality that buried gas plant wastes may be found on-site;
- Continued water quality monitoring for general water quality and PAH contaminants in the nearest water supply well (Merritt Street well).

4.3.16 Kingston

Site Description

The Kingston gas works operated for over 100 years from 1848 to 1957 on a 1.6 hectare site located north and south of Barrack Street between King Street East and Ontario Street, and Queen Street and Place D'Armes Street. The main gas works was established south of Barrack Street, auxillary gasholders were situated north of Barrack Street. The gas works was a retort coal gasification facility, a carburetted water gas facility and finally a propane air gas plant. The Kingston Public Utilities Commission (PUC) assumed operation of the gas works in 1913.

The main gas works site is now occupied by the PUC bus garage, parking lot, and office; the Kingston police underground parking garage, a Kingston Hydro substation, and retail stores. The auxillary gas holding area is now occupied by the PUC bus repair station and parking lot. Both sites are located in uncontrolled-access, public use areas. The former gas works site is located about 150 m southwest of the mouth of the Great Cataraqui River. The river has recreational use.

Potential Environmental Impact

Although the Kingston site was a large plant that operated for a long period of time, there is only limited evidence of buried wastes and potential environmental impact. No wastes were reportedly left on-site during gas works decommissioning. Also, no wastes were reported during the 1971 construction of the Kingston Police underground parking garage located on the former main gas plant site. Inspections of the parking garage, basement and sump of the Police Station and the basement and sump of the Building Inspection offices showed no evidence of gas plant wastes. Similarly no odours were

detected on-site. The only reported occurrence of possible gas plant wastes was associated with May, 1986 excavation for upgrading of a sewer on King Street, north of Place D'Armea Street and the auxillary gas holding tanks. Approximately 60 m³ of tar contaminated rock and soil was removed from the excavation. Final disposition of the wastes are not known. The lack of groundwater use and the use of and distance to surface waters also mitigate against significant potential environmental impact.

Options for Further Action

For the Kingston site, the following are considered appropriate options for further actions:

- Notifying property owners and municipality that buried gas plant wastes may be found on-site;
- Soil sampling in the area of contaminated soil on King Street to determine its composition and extent;
- If the contaminated soil is determined to be coal tar, more detailed soil sampling will be required in the area between the gas plant and the zone of contamination to assess migration potential of tar.

4.3.17 Kitchener

Site Description

The Kitchener gas plant was located on Gaukel Street between Charles and Joseph Street. The majority of the gas facilities were located on the west side of Gaukel Street but the main gas holding tank was located on the east side of the Street. The plant was initially operated by the Berlin Gas Company starting in 1882. In 1903, the gas company was purchased by the Berlin Public Utilities Commission and operated by the Commission until 1958. In about 1920, the City of Berlin was renamed Kitchener. Until about 1930, the gas process was retort gas at which time water gas production was added to the process. Based on gas plant plans from 1932, on-site tar storage areas included a tar tank, tar pit, tar dehydrator and a coal tar tank in addition to other residual tar locations, such as two gas holding tanks.

Today, the former gas plant site is occupied by the Post Office and a parking lot on the west side of Gaukel Street and the Gray Coach Bus Depot and parking lot on the east side. The Post Office is found on the northeast corner of the block and is surrounded by a paved parking lot, the western half of which is fenced with access limited to workers in the Post Office building. On the east side of Gaukel, the bus depot is located in the centre of the block and the former gas holding tank is located on property that is presently a gravel parking lot. The east side of Gaukel Street between Joseph and Charles Street is scheduled for redevelopment into a bus transportation mall.

Adjacent land use consists of commercial land use to the north, west and east and residential and commercial land use to the south. The nearest surface water body to the site is Victoria Park Lake which is located approximately 1000 m to the south.

Potential Environmental Impact

The Kitchener gas plant has had several historical and present occurrences of coal wastes being found on-site. The first documented instance of coal tar waste on-site was prior to the demolition of the gas plant in 1958. A newspaper article (Kitchener-Waterloo Record, June 7, 1958) describes the area as a former swamp that has been built up with "accumulated fill and rubbish" with "the fill in some places eight feet deep" and "it (the fill) is saturated with gas and oil and forgotten mains". The next recorded problem (Kitchener-Waterloo Record, November 13, 1963) was after the demolition of the facilities in the fall of 1963. During the paving of the parking lot for the Post Office two tar tanks and one gas holding tank were uncovered. In the process of covering one of the tanks, "sticky tar" was spread "from one end of the lot to the other". At one point, over 40 m³ litres of tar and water were removed from the gas holding tank. After attempts to drain the tar tanks failed, more than 200 tons of slag from Hamilton were poured into the tar tanks in order to stabilize the tarry material (Kitchener-Waterloo Record, December 4, 1963). The problem of excessive water in the excavation was linked to a hydraulic connection with nearby Victoria Lake. It was reported in the Kitchener-Waterloo Record (March 5, 1964) that "when water in Victoria Park Lake is raised or lowered, water on the site follows the same pattern".

The next coal tar problem occurred in the summer of 1986 when tar was found seeping into a Bell Telephone manhole on Joseph Street adjacent to the former gas site. Analytical results of tar from the manhole indicated concentrations of PAH components in excess of 10,000 ug/g. Due to the extent of tar seepage the manhole was abandoned and permanently sealed with cement.

In August 1986, a coal tar deposit was found adjacent to the CN Railway tracks on the property of Hogg Fuels Ltd. on Lancaster Street in Kitchener. According to an MOE report (F. Hicks, Cambridge District) an old trolley track running parallel to the railway tracks was used to transport tar wastes to this property during the period from 1932 to about 1958. The tar wastes were apparently dumped on both sides of the tracks. Analytical results of tarry material taken from the property confirmed the presences of many PAH compounds. More investigative work is required to confirm the origin and extent of buried waste on this property.

More recently (February, March, 1987) an on-site drilling program was completed by Public Works Canada (property owners) to determine the extent of tar contamination at the former gas plant site. Most of the boreholes drilled into the parking lot encountered tar and/or contaminated soil. Specific details of the drilling program were unavailable at the time of the writing of this report.

These specific details of on-site and possibly off-site contamination indicate that the potential environmental impacts from the gas plant site may be significant. The entire site below the parking lot and possibly below the Post Office Building contains coal tar wastes that are not contained by the original gas plant structures. Environmental impacts and health effects resulting from the migration of coal tar and contaminated groundwater may occur from the following scenarios:

- Possible seepage of waste materials into adjacent buildings (i.e., the Post Office) may result in dermal contact or vapour inhalation;
- Development of adjacent property may result in the exposure of waste material or cause contaminated seepage into excavations;

- Due to the reported hydraulic connection with Victoria Park Lake it is possible that contaminated groundwater may be migrating towards the Lake.

Further investigations are required in order to quantify the environmental significance of each of these scenarios.

Options for Further Action

A consultant hired by Public Works Canada is presently conducting additional studies on part of the Kitchener site. Pending completion and documentation of these studies, the only action required is notification of adjacent property owners and municipality that buried wastes have been found on-site and may be migrating off-site.

4.3.16 Lindsay

Site Description

The Consumers Gas Company of Lindsay, founded under the Ontario Gas and Water Act, 1881 operated a small coal gasification plant to provide street lighting to the town of Lindsay for a short nine year period from 1881-1890. In 1890, the Lindsay Electric Light Company was given the street-lighting contract. The gas works were located at 66 Williams Street. The site is now occupied by the Hydro Electric Commission of the Town of Lindsay, that maintain offices, a garage and parking lot on-site. Some of the original gas works buildings are still intact and form part of the Lindsay Hydro building. The former gas holding tank is evident through a paste up of the 1911 fire insurance plan and is located below the Lindsay Hydro garage. Settlement-induced cracks in the concrete floor of the garage define the location of the former gas holding tank. The area of the gas holding tank is separated from the parkland bordering the Scugog River by a 5 m high rock retaining wall.

Potential Environmental Impact

The very short operating period, small size, lack of any evidence of buried wastes and continued use of the property by the current owners contribute to a low assessment of potential environmental impact for this site. The basement of the Lindsay Hydro building consists of the original gas plant buildings. This basement was observed to be dry with no evidence of groundwater seepage or buried wastes. Based on observations of other sites, waste, if present, is likely to be associated with the abandoned gas holding tank. The foundation of this tank is below the Lindsay Hydro garage. Seepage of infiltrating water may leach any waste, if present to the Scugog River via the base of the rock retaining wall.

Options for Further Action

For the Lindsay site, the following are considered appropriate options for further studies:

- Although the retaining wall was inspected in the winter and no seepage was evident, reinspection during spring and summer is recommended to confirm the lack of evidence of visible waste for this site.
- Notify property owners and municipality that buried gas plant wastes may be found on-site.

4.3.19 Listowel

Site Description

The Listowel gas works was located at 46 Elma Street on the south side adjacent to the east bank of the Maitland River. The gas plant was operated by the Listowel Gas and Electric Light Company from 1891 until 1915 when the operation was discontinued. Coal carbonization was used as the gas producing process. The gas works was a small operation occupying less than 0.2 hectare.

The Andrew Malcolm Furniture Ltd. is the present occupant of the property and uses the land for lumber storage and warehouses. A small commercial building (Bonsma Pools Ltd.) is also found on the former gas plant property. Adjacent land use consists of industrial and commercial use to the north, west, south and east. The Maitland River is immediately to the east of the site and flows towards the south.

Potential Environmental Impact

There have been no reported environmental impacts resulting from waste at this former gas plant site. The site reconnaissance visit did not detect any evidence of the former gas plant, waste material or detectable odours. The potential for environmental impacts at this site is considered to be low based on its short period of operation (24 years) and its location in an industrial/commercial area. If an impact were to occur, the two most significant receptors would be the Maitland River and municipal water wells. The Maitland River is adjacent to the site and is used primarily for recreation. Listowel receives its water supply from three wells. The nearest wells are about 500 m east and west of the plant site. Recent sampling of the municipal drinking water supplies by the MOE indicates no organic contamination.

Options for Further Action

For the Listowel site, the following are considered appropriate options for further actions:

- Notifying the property owners and municipality that buried gas plant wastes may be found on-site;
- Continued water sampling of the two closest municipal water supply wells and analysis for general water quality and PAH compounds.

4.3.20 London

Site Description

The London Gas Works was a large facility (greater than 2.5 ha) located on Ridout Street between Horton (on the south), Thames (on the west) and Bathurst (on the north) Streets. The main gas facilities were located on the west side of Ridout Street but a large main gas holding tank was located on the east side of Ridout Street at Horton. The City Gas Company operated the site from 1853 to about 1939 using initially a coal carbonization process and then a water gas process to produce gas.

At present the site is a vacant lot with a vacant garage building on-site. Piles of earth and rubble, containing bricks, concrete, and piping are found in the center of the property. It is not known if this material is from the former gas plant but the Ridout Street side of the property is about 1 to 2 metres below street level indicating possible excavation. The property is presently being used as a temporary parking lot for construction workers during the construction of the adjacent Public Utilities Commission building. Adjacent land use consists of commercial use to the north and west, recreational and institutional use to the south and light industrial use to the east on the southeast corner of Horton and Ridout Street. A new Public Utilities Commission Building is under construction. The Thames River is located immediately south of the plant site on the south side of Horton Street. River level is about 5 to 6 metres below street level and flows west parallel to Horton Street then turns and flows north parallel to Thames Street.

Potential Environmental Impact

The London gas works has had a number of documented problems resulting from waste materials associated with the gas plant site.

The first occurrence of off-site contamination was associated with Phase I activities of the Horton Street Extension project. A geotechnical borehole drilled in the summer of 1983 adjacent to the river west of Thames Street intersected a layer of oil saturated sand and gravel at a depth of about 3 metres below surface. The contaminated material was limited in extent and localized to the river bank area. Analytical results from soil samples of the contaminated material collected by the MOE identified the material as a "complex mixture of high molecular weight components, resins and minerals oils, tentatively bitumen (asphalt) composition" but PAH components were not specifically analyzed. This contaminated material was excavated and removed in an environmentally secure manner as part of the construction project. The location of this off-site contamination and its limited extent suggests that it may have been an off-site disposal area for gas plant wastes.

The second occurrence in 1985 was again associated with the Horton Street Extension project. This time an oily substance was found during excavation for a storm sewer along Horton Street. The storm sewer discharges to the Thames River immediately south of Horton Street and west of Ridout Street. The contamination was found at the northwest corner of Ridout Street and the Thames River. The oily substance was not analyzed for PAH components and therefore the presence of coal tar was not confirmed.

During recent construction of the new PUC building, contaminated groundwater was found seeping into the foundation excavation. The presence of PAH compounds was confirmed in the groundwater but the extent of contaminated seepage was not reported.

Analytical results of samples of river water and oily seepage in the area of Horton Street and the Thames River where an oily odourous discharge was observed indicate the presence of trace levels of PAH. The results for the river water sample have yet to be confirmed by repeat sampling.

During the site visit, an inspection of the storm sewer outlet at the Thames River suggests that the sewer may be a possible source of the river contamination. The outlet consists of a flat concrete outfall that discharges water over gabions to the river. Water with an oily sheen was found to be discharging beneath the concrete outfall (i.e., not from the storm sewer but beneath it). Although there was no odour detected, the colour and consistency of the oil was similar to that observed on other PAH contaminated surface waters.

The potential environmental effects from this site are high and the possible effects are represented by the historical occurrences of off-site contamination. The most significant environmental impact is the potential for polluting the Thames River. This impact may already be occurring based on the unconfirmed analytical results of the river samples. Health effects may result from dermal contact with contaminated river water or sediments or the ingestion of contaminated water or aquatic life during recreational use of the river (i.e., swimming, boating, fishing).

Options for Further Action

For the London site, the following are considered appropriate options for further actions:

- Notifying property owners and municipality that buried gas plant wastes may be found on-site;
- Repeat sampling of the Thames River water to confirm (or refute) the presence of trace levels of PAH compounds;
- Sediment sampling from the shore of the Thames River adjacent to the gas plant site and analysis for PAH compounds;
- Soil sampling on-site and between the gas plant site and the river to determine extent of waste material remaining on-site and the extent of off-site migration;
- Visual inspection of the storm sewer and river bank in the spring to detect evidence of waste material.

4.3.21 NapaneeSite Description

The Napanee gas works was a small site formerly located at 46 Water Street and bounded by West and Robert Streets and the Napanee River. The plant was operated from about 1876 to 1921 initially as a coal carbonization facility but was likely converted to water gas by the early 1900s. The gas works was operated by the Napanee Gas Co. until 1882 when it was taken over by the city and operated as the Napanee Water and Electric Light Company. By 1911 the Seymour Power and Electric Co. had purchased the facilities from the town but by 1916 the Seymour Co. was purchased by the Hydro Electric Power Commission of Ontario who operated the plant until 1921 when it was closed down.

The former gas works is now occupied by a small garage and welding shop and an Oddfellows Hall and parking lot. Adjacent land use consists of residential land use to the north, west and east and recreational land use (Napanee River) to the south. An engineering plan for the stabilization of the shoreline of the river is planned. Further development plans for the area include a boat ramp and parking lot.

Potential Environmental Impact

There have been no reported problems associated with this site nor have waste materials been encountered in the area. An inspection of the welding shop which was constructed into the underlying bedrock at about the same location of the former gas house did not reveal evidence of seepage or odours.

The only potential environmental impact that may occur at this site is that buried waste materials may be encountered during bank stabilization or construction of the boat ramp. Further studies are required to determine whether or not buried wastes exist at this site.

Option for Further Action

For the Napanee site, the following are considered appropriate options for further actions:

- Notifying property owners and municipality that buried gas plant wastes may be found on-site;
- Prior to bank stabilization, soil sampling and visible inspection in the area of the bank near the former gas plant to ensure that the bank does not contain gas plant wastes and that such wastes are not released to the river during bank excavation.

4.3.22 Oshawa - Bond Street

Site Description

The Oshawa - Bond Street gas works was located on the northwest corner of Bond and Centre Streets. The layout, size and periods of operation of this facility are uncertain, as a result of poor coverage from historical references. No map of the facility exists. The operation of a manufactured gas plant at this site is confirmed by a 1903 mortgage on the property that refers to the gas house and the gas generating facilities. In 1903 the plant was purchased by the Oshawa Gas Co. In 1916, the Hydro Electric Power Commission of Ontario by virtue of the Central Ontario Power Act became owner of the site. In 1928 the Commission sold the property as a warehouse and storage area.

The former gas plant property is now in a central business district (commercial) with an eight storey office building (Durham Towers) located on the eastern part of the original site and an automotive transmission repair shop on the western part of the original site. Both of these buildings are on slab foundations and are without significant basements. Surrounding land use is principally commercial.

Potential Environmental Impact

No immediate environmental concern is perceived to exist at this site. The lack of evidence of buried waste, from geotechnical investigations and excavations conducted both on- and off-site, indicate a low potential for environmental impact and negligible health effects. Inspection of foundations during excavation for the automotive transmission building showed no tars or sludges in 1971. Geotechnical investigations for the Durham Towers Office Building in 1976 also showed no evidence of buried wastes. On-site inspection of storm sewers and an excavation immediately south of the plant site indicated no olfactory or visible evidence of buried waste. The lack

of significant basements in the Durham Towers Office Building and the automotive transmission building, and the lack of groundwater use also contribute to a low potential environmental impact at this site.

Options for Further Action

For the Oshawa-Bond Street site, the following are considered appropriate options for further actions:

- No further actions are required at this site other than notifying the present owners and municipality that buried gas plant wastes may be found on-site.

4.3.23 Oshawa - Emma Street

Site Description

This Oshawa gas works was located on the west side of the CN railway line (old Prospect Street) and north of Emma Street. The gas works was a medium-sized facility that operated from the turn of the century to about 1954, for about 53 years. The facility manufactured gas from coal for most of its history, although in later years (1950-1954) propane was manufactured. The gas works was operated by a variety of owners including the Oshawa Gas Co. (1901-1916), the Hydro Electric Power Commission of Ontario (1916-1928), the City of Oshawa and the Oshawa Public Utilities Commission (1927-1930) and Ontario Shore Gas Co. Ltd. (1931-1954). The site is now occupied by the Consumers Gas Co. who use the property as a storage area. A small office building is also maintained by Consumers Gas at 80 Emma Street. The storage area and building have controlled access as a result of a surrounding chain link fence. The former gas works property is now located within a mixed residential, commercial and light industrial use area. The site is zoned residential by the City of Oshawa. Surrounding land uses include a restaurant, railway storage yard, residences, fuel storage area and vacant land. The closest surface water body is Oshawa Creek which is less than a kilometer west of the site. No groundwater use is reported in the area of the site.

Potential Environmental Impact

Buried wastes in the form of tars and sludges are reported to exist at this site based on observations provided by an Oshawa resident who worked on the site during the 1940s and 1950s. The wastes are suspected to be located in the area of the former gas holding tanks. These tanks and the other gas plant buildings were located in the area that is now the Consumers Gas storage yard. The yard is overlain with gravel and asphalt. Odour detection in this area is complicated by the

presence of asphalt piles in the storage yard, the fuel storage area south of Emma Street and creosote-soaked railway ties in the railway storage yard north of the site. Ambient air monitoring, recently completed in the Consumers Gas building at 80 Emma Street showed below detection limit concentrations for total hydrocarbon and total aromatic vapours. These results demonstrate no health hazard from inhalation to employees working in this building.

The potential environmental impact of this site, based on currently available information, is perceived to be minimal provided that the assumed buried wastes are contained, immobile and not excavated. Evidence to support the fact that wastes may be contained and immobile is provided by observations of a shallow utility excavation on Emma Street immediately south of the site. No gas plant wastes were observed in this excavation during the site inspection. The lack of groundwater use and the distance to surface water also act to lessen potential environmental impact at this site.

Options for Further Action

For the Oshawa-Emma Street site, the following are considered appropriate options for further actions:

- No further actions are required at this site other than notifying the present owner and municipality that buried gas plant wastes may be found on-site.

4.3.24 Ottawa, King Edward and York Streets

Site Description

The Bytown Consumers Gas Co. operated a retort coal gasification plant of large size at the southwest corner of York and King Edward Streets for street lighting starting in about 1854. The plant operated for about 65 years or until some time in the late 1910s or 1920 at which time the facilities of the Ottawa Gas Co. were relocated to the Lees Avenue site. In the 1880s, the plant employed 25 people and had three large gasometers as well as underground tar wells and tar condensers and gas purifying equipment.

The site is now occupied by a Federal Government Office building and parking lot in a residential and public use area. A child care centre is located on the adjoining southerly property with parking lots and residences located on other surrounding properties. Two large former gas holding tanks are located below the front lawn of the federal building with a third tank and underground tar well situated below the building.

In 1986, the owner of the property, Public Works Canada, commenced excavation as part of an upgrading and redevelopment of the existing building which was originally built in the 1940s. During excavation of the basement and outside of the building, black tar was encountered. Upon advice of Environment Canada and the Ontario Ministry of the Environment, the property owner retained a consultant to assess the coal tar contamination problem at this site. Soil borings and sampling of soils and groundwater have been undertaken at the site on behalf of the owner.

Potential Environmental Impact

Site investigations undertaken on behalf of the owner of the property have shown the occurrence of "black odourous substances" in the majority of the 31 boreholes drilled from within and outside of the existing building. These gas plant wastes were found both within and outside of tanks and other structures where tars were expected to accumulate. Chemical analyses of the soil and groundwater samples collected from the site investigation program have shown the presence of PAH characteristic of coal tar. On-site inspections of the sumps in the basement of the federal building have identified the presence of coal tar. An estimated 200-300 L of tar are located in the bottom of the boiler room sump.

Given the widespread occurrence of tars on-site and in the sumps there is potential environmental impact related to off-site migration of the wastes and to inhalation of airborne PAH by federal employees working in the building. However, preliminary results from an air monitoring program conducted by Health and Welfare Canada and reported by Public Works Canada staff have shown negligible levels of airborne gas plant wastes and therefore no hazard to human health from such inhalation. The presence of pure coal tar within the boiler room sump is a potential hazard to health for employees who may service or clean the sump both in terms of inhalation and dermal contact. Also the presence of tar within the sump will result in discharge of PAH contaminated water and coal tar to the City sewer system.

Off-site migration of gas plant wastes is likely given the occurrence of coal tar near the property boundary, particularly to the northeast along King Edward Avenue. Migration of wastes to the southeast toward the child care centre appears less likely. Air monitoring of the child care centre recently conducted by Health and Welfare Canada and reported by Centre staff has shown no detectable

airborne contaminants attributable to coal tar wastes. Inspection of the basements and sump of the child care buildings show no visible or olfactory evidence of gas plant wastes.

Options for Further Action

A consultant hired by Public Works Canada is presently conducting studies on the Ottawa-King Edward site. Pending completion and documentation of these studies, the only immediate action required is notification of the property owners and the municipality that buried wastes are located on the former gas plant property and may be migrating off-site.

4.3.25 Ottawa, Lees Avenue

Site Description

Sometime between 1915 and 1920, the Ottawa Gas Co. relocated its gas works from the King Edward Street - York Street location to the site at 175 Lees Avenue. The Lees Avenue gas works was a large facility that operated for about 37 years or until 1957 when natural gas pipelines made the operation uneconomical. The plant was operated under different company names including the Ottawa Gas Co., Ottawa Heat, Light and Power Co., Interprovincial Utilities Ltd. and Consumers Gas Co. The site is located on the north side of Lees Avenue, south of Highway 417 and between Lees Avenue on ramps to the west and the Lees Avenue overpass to the east.

Gas plant operations changed from retort coal gasification to carburetted water gas in the late 1930s. Comprehensive air photo coverage of the site is available for the period 1925 to present. The site was demolished in 1966-67. The site is located 150 m northwest of the Rideau River.

In 1981-83, the site was developed as a below ground bus transitway station by the Regional Municipality of Ottawa-Carleton. Because the bus station is below the groundwater table, continued pumping is required to prevent the bus station from flooding. A 1220 mm diameter storm sewer was constructed to discharge the pumped water from the transitway station directly to the Rideau River.

The site is now occupied by the Lees Avenue transitway station and parking lot, a Consumers Gas metering station, an existing high rise apartment building (169 Lees Avenue - constructed in 1985) and vacant land proposed for development as a high rise apartment building.

Potential Environment Impact

Environmental impacts have already occurred for the Lees Avenue site. In late April 1986, tars were observed in the pumphouse of the Lees Avenue transitway station and in the adjacent Rideau River in the vicinity of the outfall from the pumping station. The discovery of this contamination resulted in closure of the Lees Avenue station and installation of a boom to contain the oil slick on the Rideau River. Subsequently, a leachate collection and treatment facility was constructed to collect and treat coal tar contaminated water at the transitway station and removal of an estimated 40 m³ of tar from the bottom of the River over a 100 m by 40 m area has been undertaken. Clean-up of the River is ongoing and will resume in spring 1987.

Drilling and sampling investigations conducted on the property at 169 Lees Avenue have shown that the foundation of the 4,250 m³ gas holding tank is contaminated with coal tar. An underground parking lot and a second high-rise apartment building are planned for this property. A potential environmental impact exists for this site as a result of excavation of buried wastes and exposure of these wastes to workers involved in the excavation. Approval for this development is pending subject to the results of site investigations undertaken by the Ontario Ministry of the Environment.

In addition to the gas works, a tar distillation plant operated south of the gas works and Lees Avenue from about 1920 to sometime in the late 1940s. This facility distilled coal tars received from the gas works and later from other sources. Because this facility handled and processed coal tars, it is a second industrial source of coal tar contamination in the Lees Avenue area. The plant was located on what is now 170 Lees Avenue. A high-rise apartment building now occupies the site. Soil and groundwater contamination have been discovered at this site, beside and below the 170 Lees Avenue apartment building.

Options for Further Action

Consultants hired by the Regional Municipality of Ottawa-Carleton and the Ontario Ministry of the Environment are presently conducting studies and remedial actions at the Ottawa-Lees Avenue site. Pending completion and documentation of these studies no further action is required, at this time.

4.3.26 Owen Sound

Site Description

The Owen Sound gas works was an intermediate-sized facility that operated as a retort coal gasification plant (1888-1938) and later (1939-1947) as a coke oven plant for a total period of 59 years. The gas works were operated under a series of different names including Owen Sound Gas Light and Fuel Co. (1888-1892); Owen Sound Gas Light Co. (1892-1912); Owen Sound Gas Department (1912-1915); and the Public Utilities Commission of Owen Sound (1915-1947). The former street address for the plant was 1141-1145 First Ave. E. The plant was bounded by First and Second Ave. E. and Eleventh and Twelfth St. E.

The former gas plant property is now occupied by the Brewer's Retail Store and the Liquor Control Board of Ontario store and associated parking lots. Both stores do not have basements. The site is now located within a mixed commercial-residential area and is assessed a high ranking in this category. Adjacent land use includes residences, parking lot, grocery store, railway station and machine shop. The site is essentially adjacent to the Sydenham River which forms part of Owen Sound harbour. The surface water use in this area is recreational. The drinking water supply for the City of Owen Sound is obtained from Owen Sound (Georgian Bay). The intake is about 6-7 km northeast of the former gas plant site. No groundwater use is reported within the area of the former gas plant site.

Potential Environmental Impact

No immediate environmental impact or adverse health effect is evident for the Owen Sound site. The buildings currently on-site and most of the buildings on adjoining properties do not have basements and therefore are unlikely to have disturbed gas plant wastes if they are in fact buried at this site. On-site inspections of the property and

adjacent harbour showed no visible or olfactory evidence of buried wastes. The harbour is separated from the site by a concrete and steel wall of uncertain depth. The wall depending on Construction details may act to prevent wastes from entering the harbour.

While no immediate environmental impact or adverse health effect is evident for this site, the size of the site and its duration of operation suggests that some wastes are likely buried on-site. In particular, an historical account of tar-handling procedures provided by a former gas plant employee suggests that some tars are buried on-site. The 1923 fire insurance plan also suggests buried wastes with the existence of an underground tar tank located beneath First Ave. E.

Options for Further Action

For the Owen Sound site, the following are considered appropriate options for further actions:

- notify the present owners and municipality that buried gas plant wastes may be found on-site and below First Ave. E.
- detailed inspection of street sewer lines particularly those on First Ave. E., to evaluate potential influx of tars. Sampling of sediment in storm sewers might also be considered.

4.3.27 Peterborough

Site Description

The Peterborough gas works was a large manufactured gas plant that operated for close to 80 years on the northside of Simcoe Street between Queen Street and the Otonabee River. The plant operated as a coal gasification plant and later as a carburetted water gas plant and possibly as a propane facility in the 1950's. Today the site is utilized principally as a parking lot and as a provincial court building. The site has uncontrolled access and is considered public use. The site is within 45 m of the Otonabee River. The Otonabee River has mostly recreational use. Brick work as part of a former 20,000 ft³ capacity gas holding tank is visible in the northwest corner of the site.

The site is characterized by a sloping land surface from the northwest across the site to the southeast toward the Otonabee River. The change in elevation from the northwest corner of the site to the Otonabee is about 25-30 ft. The soil stratigraphy, as determined by 1973 and 1982 soil borings, is oily contaminated fill overlying alluvial deposits (silt, sand, gravel) which in turn overlie a dense till. The fill and alluvial deposits thin to the northwest away from the river. In the northwest corner of the site the till unit is near surface. Some oil (tar) contamination was also noted in the alluvial deposits that overlie the till.

Potential Environmental Impact

The site size, soil conditions, duration of operation, current land use, proximity to the Otonabee River and evidence of buried waste and tar contamination problems result in a high potential environmental impact for this site.

Site investigations using soil borings conducted in 1973 and 1982 identified widespread oil (tar) contamination in the fill and coarser grained alluvial deposits of the site to depths of 5 m. Most of the fill and alluvial deposits have been described as very oily. In 1982-83, excavation for the provincial court building encountered oily contaminated fill to depths of 3 m. This fill was removed from the site and disposed at an unknown location. Since construction of the court building there have been some complaints of odours of unknown origin in the building in the area of the Judges Chambers.

In February, 1986 excavation for installation of a watermain on the bank of Otonabee River adjacent to the site released an unknown volume of tar from the bank of the River into the River. The release of this tar resulted in an oil slick over a large area of the River in the vicinity of the excavation. A sample of the tar collected and analyzed by the Ontario Ministry of the Environment showed constituents similar to coal tar. Also, divers involved in the installation of the watermain through the River bed reported skin rashes and swollen lips, symptoms related to skin contact with polynuclear aromatic hydrocarbons. However, the exact reasons these symptoms in this instance are not known.

The soil stratigraphy and groundwater conditions at this site are likely to enhance migration of gas plant wastes such as coal tar toward the Otonabee River. The oils and tars identified in soil studies were observed within the fills and coarse grained alluvial deposits. These soils are underlain by a dense, till likely of low permeability. The till surface slopes from the northwest to the southeast towards the Otonabee River and may funnel dense non-aqueous phase contaminants such as coal tar toward the River. In addition to this sloping, low permeability surface the groundwater flow is toward the River and this will also enhance migration of both non aqueous phase and aqueous phase contaminants toward the River.

Based on the observations of tar on-site and off-site and known soil conditions, there is a strong likelihood that off-site migration of gas plant wastes is occurring at the Peterborough site and that these wastes may be entering the Otonabee River. However, because of the high fluid velocities in the River in the vicinity of the site, and the likely low waste seepage rates, evidence of such migration is not expected to be readily visible on the surface of the River.

Several actions have recently been carried out at the Peterborough site. The municipality, site owners and other interested parties have been informed of the presence of coal tar waste on the site. The Ministry of Labour has carried out some air quality monitoring of the court house building and further testing for PAHs is planned.

Recent drilling and soil sampling conducted by the City of Peterborough has indicated the presence of coal tar at several locations on the gas plant property and close to the Otonabee River.

Options for Further Action

For the Peterborough site, the following are considered appropriate options for further actions:

- conduct air monitoring in problem areas of courthouse to determine air-borne PAH and light aromatic concentrations;
- detailed inspection of sewers to assess possible influx of gas plant wastes, sampling and analysis of water and sludge for PAH if tars are suspected;
- detailed inspection and sediment sampling of the bank of the Otonabee River adjacent to the former plant and south of Simcoe St. to assess potential discharge of wastes to Otonabee River.

4.3.28 Port Hope

Site Description

The Port Hope gas works was a small retort coal gasification plant that operated for about 80 years between 1859 and 1939 under various names including the Port Hope Gas Light Company, the Port Hope Gas and Light Co. and the Hydro Electric Power Commission of Ontario. The site is situated on the west side of John Street between Park and Alexander Streets. The former gas plant property is now a vacant lot owned by the Corporation of the Town of Port Hope. The property is situated within a residential area with some commercial land use on the east side of John Street. The site is hydrogeologically characterized by a high groundwater table with numerous springs and areas of groundwater discharge as a result of a local topographic high to the northwest of the site. Some remnants of a former building (likely the gas works building) are evident on-site.

Potential Environmental Impact

No information on soil borings or excavation was obtained for the Port Hope site. The only evidence of buried wastes at this site is from a hydrocarbon odour detected in the storm sewer manhole on the west side of John Street at the corner of Alexander Street.

Although groundwater levels are high, no groundwater use exists within the area of the site. Drinking water is from Lake Ontario with the pumping station located about 800 m south of the former gas works site.

Based on available information, the Port Hope site currently is considered not to pose a significant environmental impact. However because of the discharging groundwater conditions in the area and the odour detected in the storm sewer, the site assessment may change if the site is inspected during the spring when groundwater levels will be highest.

Options for Further Action

For the Port Hope site the following are considered appropriate options for further action:

- notify property owners and municipality that buried wastes may be found on-site.
- reinspect the site in the spring to look for contaminated discharge in the area of the springs.

4.3.29 Port Stanley

Site Description

The historical information for the Port Stanley gas plant site is uncertain primarily due to the lack of historical maps for the site. The site is located on Carlow Road. The available information, most of it unconfirmed, indicates the site was owned by Southern Ontario Gas Company from the 1920s to the 1930s and Dominion Gas Company from the 1930s to the 1950s. The gasification plant was most likely built in the late 1940s (possibly 1948) and operated, perhaps intermittently, until at least the late 1950s. Although it is not well documented, the gasification process was most likely an oil gas process using oil supplied from bulk storage tanks. In the 1970s, the property was occupied by Shamrock Chemicals Ltd. and Ultramar Canada Inc. Shamrock Chemicals produced solid fertilizer using spent sulphuric acid as an ingredient. Ultramar owned two large bulk fuels tanks located south of the gasification facilities.

Today, Shamrock Chemical is still located on the property and many of the original gas facilities are still in place but have been modified for the production of fertilizer. The gas holding tanks, still on-site, are the most obvious indication of the former gas works. In addition, several other tanks containing acids are found on the site. Ultramar's bulk storage tanks have been removed but the concrete foundation remains. Adjacent land use consists of agricultural land use to the north and west, residential land use to the south, and recreational land use to the east. A proposal has been submitted to redevelop the site into a oil re-refinery. The site is located adjacent to Kettle Creek which flows south to Lake Erie.

Potential Environmental Impact

The Port Stanley gas plant has had several impacts on the environment. The most significant impact occurred in November, 1986 when an oil tar "blob" was found in Kettle Creek at the mouth of a ditch that drains the property. The open ditch is referred to as the George Street Drain and runs from George Street, along the southern edge of Ultramar's and Shamrock's property, to a culvert under Carlow Road and finally discharges from the culvert to Kettle Creek. The oil tar "blob" was derived from the gas plant and seeped into the ditch near the property where it drained to Kettle Creek. The tar deposit was reported to cover 15 metres of the creek bottom and contained 5-200 ppm of PAH. PAH contamination was not detected downstream nor in the Port Stanley water supply located on Lake Erie, 1 km from the mouth of Kettle Creek.

Shamrock Chemicals has had other environmental problems associated with the operation of the fertilizer plant. Acid spills and acid seepage have been reported entering the drainage ditch. The discharges to the creek are complicated by the presence of oil tar in the waste acid. Over one million litres of waste acids and oily sludge is reported to be stored on-site.

The chemical company is presently under a control order by the MOE and clean-up of the site and hydrogeologic studies are underway.

In its present state, the potential for further environmental impacts at this site is considered to be high. This assessment is based on existing oil tar seepage to the ditch and the presence of on-site wastes and extensive water pollution. MOE is presently studying this site in order to reduce future impacts.

Development of this site into an oil re-refinery may result in an increase in the potential environmental impacts unless remediation measures are implemented prior to redevelopment.

Options for Further Action

Consultants hired by the property owners are presently conducting additional studies on the Port Stanley site. Pending completion and documentation of these studies, the only action required is notification of the property owners and municipality that buried wastes may be found on-site and may be migrating off-site. The Ontario Ministry of the Environment is continuing to study this site to ensure that the site meets regulatory requirements.

4.3.30 St. Catharines

Site Description

The St. Catharines gas works was a large facility (1.4 hectare) which operated from 1853 to sometime in the mid to late 1920s. The gas company was originally operated by the St. Catharines and Welland Canal Gas Light Co. (1853-1903) and later by the St. Catharines Gas. Co. (1903-1928). The City of St. Catharines acquired the gas company in 1912. The gas manufacturing process was likely retort coal gasification.

The gas plant was located on the southside of Gale Crescent at the bottom of Calvin Street beside the Old Welland Canal. Old photographs and plans show three gas holding tanks located adjacent to the old Welland Canal and south of the gas plant buildings. The former gas plant, property is now zoned greenbelt, owned by the City of St. Catharines and known as the St. Catharines Centennial Gardens. The site is public use, with uncontrolled access and is located within a general residential, recreational and commercial land use area. The closest surface water is the Old Welland Canal, which is polluted with other industrial wastes. The only sewer in the area is a storm sewer that discharges to the Old Welland Canal southwest of Calvin Street in the general vicinity of the former gas plant.

Potential Environmental Impact

Although the St. Catharines gas works was a large facility which operated for more than 60 years, the lack of evidence of buried wastes indicates a low assessment of potential environmental impact. Inspection of the site showed no evidence of the existence of a former manufactured gas plant. However, odour detection of gas plant wastes at the site was hampered as a result of the strong odours of pulp and paper wastes in the Old Welland Canal.

While there does not appear to be any immediate environmental impact or health effect at this site, we expect, based on the results for other sites, that gas plant wastes especially tars and sludges are likely buried at this site. The lack of any significant excavation or soils investigations at the site contributes to the uncertainty with regard to subsurface conditions.

Inspection of the storm water outfall to the Old Welland Canal was also inconclusive as the water in the sewer was frozen and outfall was snow covered. Reinspection of this outfall in warmer weather, particularly during spring snow melt is recommended and may result in a different site assessment with respect to evidence of buried wastes.

Options for Further Action

For the St. Catharines site the following are considered appropriate options for further action:

- notify the present owners and municipality that buried wastes may be found on-site.
- reinspect the storm sewer outfall in the spring in order to assess whether wastes are present.
- reinspect the bank of the canal in the spring to look for evidence of buried wastes and discharges to canal.

4.3.31 St. Thomas

Site Description

The St. Thomas gas works occupied the northern three-quarters of the block (approximately 1.5 ha) bounded by Scott (formerly Gas), Mondamin, Curtis and St. Catherine Streets. The facility was operated by the St. Thomas Gas Company from 1877 to 1901, the City of St. Thomas Gas Department from 1901-1930 and the Gas Commission of St. Thomas from 1930-1935 for a total operating period of 58 years. Gas was produced by a retort process initially but a water gas facility was also present by 1930.

Today the property is occupied by the St. Thomas Public Utilities Commission who have a hydro substation, garage and office on the northeast quadrant of the block and a small plaza with stores and offices on the northwest quadrant of the block. Adjacent properties consist of residential land use to the north, west and east and institutional (police station and library) land use to the south. The nearest surface water body is Kettle Creek located approximately 0.9 km to the northwest but a small creek drains the area of Hiawatha and Owaisa Streets approximately 180 metres northwest of the site.

Potential Environmental Impact

The St. Thomas gas plant site has had several reported instances of on- and off-site evidence of buried gas plant waste. During the construction of the Scott-Kains Street Jog Elimination Road and Sewer Construction Project (City of St. Thomas, 1969) wastes in several forms were encountered. This project realigned Scott Street to connect with Kains Street and eliminated Gas Street in the process. The jog elimination resulted in road and sewer construction across the northwest corner of the gas plant property. By comparison of the gas plant historical map from 1929 with the jog elimination construction

plan it is apparent that the construction would have intersected several former gas plant structures including the retort house, a small gas holding tank and possibly an underground creosote (tar) tank. Geotechnical boreholes, drilled as part of this project, intersected fill material containing cinders, ashes, brick, glass and black organic material. In one of the boreholes, located to the east of the former gas plant a slight organic odour was detected. Most of the fill material is associated with a buried creek bed. The creek, prior to being filled, is apparent on a historical map from 1877, and extends across the gas plant property from southeast to northwest. It is likely that the creek was filled in with waste material, mostly ashes and cinder from the gas plant.

During construction of storm sewers along the newly constructed Scott Street, a large volume of "deleterious" material was removed from the area between Mondamin and Hiawatha Streets to a depth of about 7.6 m below surface. Although it is not stated it is likely this material was fill material associated with the buried creek bed. The disposal location of the excavated material is unknown.

During the site visit and inspection of the PUC buildings two PUC employees reported evidence of buried tar on-site. The first report referred to tarry material in an excavation during the construction of the storm sewer on Scott Street. The approximate location was the corner of Scott and Mondamin Street. The second report described oil and tar material in an excavation on the PUC's property. The excavation was abandoned and filled in. The approximate location was in the area of the former gas purifying house and the gas holding tank. An inspection of the basement of the hydro substation (corner of Scott and St. Catherine) did not detect odours or tar seepage in the building sumps.

This site has evidence to support the interpretation of buried wastes on-site and possible migration off-site. The most likely migration pathway would be in the buried creek bed as this channel would be relatively permeable. If this is the case the migration direction is to the northwest towards a residential area and into the small creek at Hiawatha Street. In addition, several institutional buildings to the south have basements and may be affected by tar seepage. The potential environmental impacts for this site require further investigations.

Options for Further Action

For the St. Thomas site the following are considered appropriate options for further action:

- notify the property owners and municipality that buried wastes may be found on-site;
- off-site soil sampling of storm sewers and building sumps around the plant site and in the area of the buried creek bed is necessary;
- if significant off-site contamination is found, soil sampling on-site and visual inspection for gas plant wastes to determine extent of waste material on-site is required.

4.3.32 Sarnia

Site Description

The Sarnia gas works was located on Maxwell Street and occupied about 0.5 ha of land on the southern portion of the block bounded by Maxwell, Water, Front and Nelson Streets. The gas plant was operated by Sarnia Consumers Gas Company from 1884 to 1893, and the Sarnia Gas and Electric Light Company from 1893 to 1909. In 1909, the Sarnia was converted to natural gas supplied to the city by pipeline.

The property is now occupied by Sarnia Hydro who operate a hydro-electric substation. The former gas plant property is fenced and access is controlled by a locked gate. Sarnia Hydro has plans to sell the property in order to build a new hydro station on adjacent property. Adjacent land use consists of commercial/residential to the north, recreational to the west, and residential to the south and east. The former gas plant site is located 125 m east of the St. Clair River.

Potential Environmental Impact

The Sarnia gas plant site has had no reported occurrences of on-site wastes and no problems with waste or odours have been reported. A site inspection of the basement of the hydro substation, the only building existing on-site, did not detect odours or contaminated seepage. Waste materials were not reported in excavations in the area of Water, Maxwell and Front Streets during the construction of storm and sanitary sewers and watermains. One geotechnical borehole located on the southeast corner of Maxwell and Front Streets intersected cinders near the surface in fill material.

The potential for environmental impacts from this site is considered to be low at this time based on the site's short operating period and lack of evidence for on-site waste. The possibility exists that waste may be buried on-site and that future development may occur on-site exposing these wastes during excavation.

Options for Further Study

For the Sarnia site the following are considered appropriate options for future actions:

- notify property owners and municipality that buried wastes may be found on-site.
- if the site is to be developed, soil sampling on-site is required to determine whether or not buried wastes are present.

4.3.33 Sault Ste. Marie

Site Description

The Great Northern Gas Co. purified and distributed coke oven gas to the City of Sault Ste. Marie from about 1925 to 1963. The gas was produced by the Algoma Steel Corporation, which was located one block south of the Great Northern Gas Co. property. There is some historical reference to earlier manufactured gas companies such as the Sault Ste. Marie Water, Gas and Light Co. however, no other details of earlier gas plant operation are available.

The Great Northern Gas Company's facilities were located on the southwest corner of Goulais Avenue and Bonney Street. The site is currently an uncontrolled access parking lot owned by Algoma Steel. Adjacent property use is primarily industrial, with some residences located north of the site. There is no available history of excavation at the site, other than installation of watermains and sewers along adjacent streets. There are currently no plans to redevelop the site. The closest surface water body is East Davignon Creek which is located 100 m southeast of the site. Some drinking water supply to the City is obtained from confined deep bedrock wells located 1.5 km north of the site. This site was not inspected.

Potential Environmental Impact

Because this property was used principally for gas purification and distribution, it is not likely that significant quantities of gas plant wastes in the form of tars or sludges would be disposed on site. These wastes were generated by Algoma Steel and would have been sold as a by-product or re-used as fuel. Given the current and planned land use, site location, lack of reported evidence of buried wastes and resource characteristics, no significant environmental impact or adverse health effect is perceived to currently exist at this site.

Options for Further Action

For the Sault Ste. Marie site, the following are considered appropriate options for further action:

- no further actions are required at this site other than notifying the present owners and municipality that buried gas plant wastes may be found on-site.

4.3.34 SimcoeSite Description

The Simcoe gas works was a small gas manufacturing facility that operated for a short period of time at the southeast corner of Pond and Water Streets from about 1891 to sometime in early to mid 1910s. The gas works was dismantled and a shoe factory established on site in 1916. Some of the original gas plant buildings are intact today and house the City of Simcoe Information Centre. The only historical map available for the site is a gas main map that was part of the 1906 lease agreement between the Simcoe Gas and Water Co. Ltd. and the Dominion Natural Gas Co. Ltd. Based on this map, the former gas holding tank was situated south of the gas plant buildings. A part of the Senior Citizens Centre likely now overlies this former gas holding tank.

The site is now a public use facility, located in an open space, residential institutional land use area. Site access is uncontrolled. The site is situated adjacent to the Lynn River which has recreational use in the area of the site. The potential for excavation at this site is low because the original gas plant buildings are protected under the Ontario Heritage Act.

Potential Environmental Impact

The only evidence to suggest the existence of any significant environmental impact and adverse health effect at this site is the reported occurrence of odours (oily, sewer gas?) in the north end of the Senior Citizens Centre. Intermittent odours in this building have been reported over several years since renovation of the building reportedly in the early to mid 1970s. The odours were of sufficient strength and persistence in 1986 to warrant excavation of the floor in the north end of the Centre. An open pipe/sewer was exposed and later

filled with concrete. This appears to have rectified the odour problem. Although no gas plant wastes were observed during this excavation, the location of these odours (i.e., similar to the assumed location of the former gas holding tank) suggests but does not prove a possible link with the former gas plant. The odours are now reported to be no longer persistent or problematic.

Site inspections of storm water drains from the parking lot beside the Information Centre to the Lynn River were observed to be clean with no visible or olfactory evidence of gas plant wastes.

Options for Further Action

For the Simcoe site, the following are considered appropriate options for further actions:

- no further actions are required at this site other than notifying the present owners and municipality that buried gas plant wastes may be found on-site.

4.3.35 Stratford

Site Description

The Stratford gas works was located on Wellington Street north of St. David Street adjacent to the Canadian National Railway tracks. The main gas facilities were located on the east side of Wellington Street and the main gas holding tank was located on the west side of Wellington Street. The Stratford Gas Company operated the gas works from 1875 to 1925 producing retort gas then water gas. The facility was taken over by the Stratford Public Utility Commission and operated from 1925 to 1953.

Today, the property is still occupied by the PUC. A service centre (repair garage and storage yard) is located on the east side while an administration and office building is found on the west side of Wellington Street. One of the original buildings, the gas purifying house, remains on the site and is used as a garage. The service centre yard is a controlled access area with a fence and gate. Adjacent property consists of residential land use to the north, west and south and industrial land use to the east.

Potential Environmental Impact

The Stratford gas works has had construction on top of the gas facilities but there have been no reported occurrences of gas plant wastes. The service centre, built in 1956, covers the area formerly occupied by the retort house, condenser and purifying house and the relief gas holding tank. The administration building was built in 1955 and required the excavation of the main gas holding tank. Neither of these construction projects indicate buried wastes but only the administration building would have required a foundation excavation. These projects were completed in the late 1950s and it is possible

that waste material could have gone unreported. Interviews with PUC employees provided no indications of problems from the former gas plant. The site visits also did not reveal odours or evidence of wastes.

The only indication of possible buried wastes is from gas plant plans provided by the PUC where two tar wells (capacity 16.8 m³ and 9.5 m³), a tar dehydrator chamber and a liquor well (capacity 19 m³) are shown at the northeast corner of Wellington Street and the railway tracks. This area is relatively untouched by construction and it is possible that this stored waste still remains in the ground.

Based on the existing information, the potential for environmental impacts is considered to be low primarily because on-site wastes have not been identified. This assessment could change and be elevated to a high potential if the tar wells are identified as containing waste material. The high potential environmental impact results from the presence of a municipal water supply well located on the eastern portion of the property. This well is over 60 metres deep with 30 metres of casing through confining clays and is unlikely to be contaminated from surface waste but the potential must be considered. Water quality sampling at the municipal water supply well located on-site and analysis of samples for PAH compounds has been done and no PAHs were found in the water.

Options for Further Action

For the Stratford site, the following are considered appropriate options for further actions:

- notify property owners and municipality that buried gas plant wastes may be found on-site.
- geophysical surveys (e.g., ground probing impulse radar) to identify the location of buried tar tanks and wells.

4.3.36 Toronto - Station A

Site Description

The large gas works known as Station A was operated for over 100 years from 1841 to 1954 in the general area of Front Street East and Parliament Street. The Station A gas works were operated primarily by Consumers Gas Co. on several properties in the general site area. The site is the largest retort coal gasification and carburetted water gas plant identified in this study.

The Station A site includes the original gas works for the City of Toronto that was located on the west side of Princess Street between Front Street East and the Esplanade. This site was one block west of the main Station A site. The site likely commenced operation in 1841 by the Toronto Gas, Light and Water Commission. In the late 1840s and 1850s, the site became incorporated into the main Front Street East gas works of Consumers Gas. The gas works at the Princess Street site likely ceased operation in 1855 although documentation shows that a gas house existed on the site in 1875. The Princess Street site is now used by the Canada Post Corporation as a truck depot and parking lot.

The main Station A site was operational from 1848 to 1954. During this period of time, the Consumer's Gas Co. operated many different gas manufacturing facilities in the Front Street East - Parliament Street area. The former gas plant properties now include:

- The Canadian Opera Co. property at the southwest corner of Front Street East and Berkeley Street;
- The Greenspoon Bros. Ltd. property located immediately south of the Canadian Opera Company and used as Greenspoon offices and a rehearsal hall and workshop space by the Toronto Free Theatre;

- Fuhiman Auto Ltd., Plashkes and Zitney Ltd. and a numbered Ontario Co. properties between Berkeley and Parliament Streets south of Front Street East;
- The property of Toratar Publishing Ltd., Bresler Realty Ltd. (gas station) and Toronto Transportation Commission bounded by Berkeley Street and Front Street East, Parliament Street and King Street East;
- Parking Authority of Toronto property now the Metropolitan Toronto Library site (under construction) located on the southeast corner of Front Street East and Parliament Street;
- Numbered Ontario Co. (Dodge car dealership) and Consumer's Gas Co. properties between the library site property and Trinity Street, south of Front Street East;
- Runneymede Investment Corporation property (original gas plant building now vacant) located on the north side of Front Street East between Parliament Street and Erin Street.

The current land use for the Toronto Station A site is mixed with light industrial, commercial, institutional and public uses identified. The Toronto Station A site was located in a former industrial area which through the years has evolved to commercial and more public land uses. Residential and public use areas are presently located to the south of Station A. It is clear that redevelopment will occur in this area as demand for downtown property increases. The recent construction for the Metropolitan Toronto Library site and the proposed development of the Greenspoon Bros. property are examples of this development.

Review of some of the available historical maps is valuable in identifying the location of former gas plant facilities and in assessing the potential environmental impacts for each property. Because no historical maps are available for the Princess Street site, no detail can be provided on layout of these gas plant facilities. The property of the Canadian Opera Company was formerly used as a gas purifying house (original building still stands) and contained several underground tar tanks and oxide sheds. The Greenspoon Bros. property was the location of a former condenser house and exhauster house and contained several underground tar, liquor and ammonia wells. The property south of Front Street East between Berkeley and Parliament Streets contained coal sheds, coke sheds, offices and a large retort house. Property north of Front Street East between Berkeley and Parliament Streets was not extensively used for gas production. The Parking Authority of Toronto site (Library site) was the location of coal sheds, coke sheds, underground tar wells, oil tanks and a water gas house. The adjacent property to the east to Trinity Street was used principally for surface gas holding tanks. The property north of Front Street East between Parliament and Erin Streets was used as a water gas purifying area and housed water gas purifiers and oxide sheds. The original water gas purifying building still stands and is vacant.

The closest surface water body to the site is Lake Ontario which is located about 200 m south of the site. The Lake was closer to the site during early plant operation as a result of recent land reclamation.

Potential Environmental Impact

Significant environmental impact and potential adverse health effects are perceived to currently exist at this site at those locations where waste materials of concern have been identified. The recent development of the former City parking lot for the Metropolitan Toronto Library unearthed tars, and sludges and distinct tar odours

were observed on-site. A consultant was retained by the property owner to assess and remediate the tar contamination problem at this site. Potential environmental impacts at this location relate to off-site migration of contaminated water and tars to City sewers, and nearby Lake Ontario.

The most pressing and significant concern for potential adverse health effect and environmental impact is associated with the property of Greenspoon Bros. Ltd. at 26 Berkeley Street (the area of the former condenser and exhauster houses). Inspections of the property revealed an odour of tar in the rehearsal hall of the Toronto Free Theatre. This odour was strongest in the sub-basement of the rehearsal hall where free uncontained tar was observed on the sub-basement floor. These occurrences of tar contamination prompted the retention of a consultant by the City of Toronto. The City is involved with a transfer of ownership of the site. The consultant has subsequently performed, during December 1986, air monitoring and tar and water analyses that confirm the presence of PAH and phenolic compounds. Although the airborne PAH compounds do not exceed Ontario Ministry of Labour standards, the odours are reported by Toronto Free Theatre staff to be significantly stronger during summer months when volatilization of vapours is expected to be greatest. Tar and water samples showed total selected PAH contents of 3800 and 18.6 ppm, respectively (Proctor and Redfern Group, 1987). The work conducted by this consultant also identified and investigated several underground tanks at the site and concluded that about 2250 m³ (500,000 gallons) of PAH contaminated liquids and sludges exist at the site (Proctor and Redfern Group, 1987). Site investigations also indicated widespread contamination of soils with tars and sludges.

Given the widespread soil contamination and high volumes of liquid waste identified at the 26 Berkeley Street property, there is concern over migration of wastes off-site and into City sewers and groundwater. The lack of any groundwater use in this area mitigates

some of the environmental impact. However the presence of PAH odours which will likely increase in intensity during the spring and summer months and the presence of uncontained coal tar in the sub-basement of the rehearsal hall, pose an immediate concern requiring remediation.

In addition to this problem area, odours were observed on the property on the north side of Front Street East between Parliament and Erin Street (former water gas purifying area). This is likely indicative of buried wastes at this site.

The property of the Canadian Opera Company at the southwest corner of Front Street East and Berkeley Street is thought, based on previous gas plant operations, to have subsurface contamination. A large rectangular tar tank is located below the rear parking lot of the Opera Company building, just north of the rear laneway. Tars and sludges have been observed in this tank (Proctor and Redfern Group, 1987).

In summary, to date only selected areas of the overall Toronto A site have been investigated and these studies have shown that a significant potential environmental impact and possible adverse health effects exist in these areas. Given the size, duration, location and likely development and excavation at the site, there is a strong possibility that other environmental impacts are occurring at other locations of this large site.

Options for Further Actions

For those parts of the Toronto Station A site where coal gasification - related wastes are or may be located, the following are considered appropriate options for further actions:

- notify property owners and municipality that buried gas plant wastes may be found on-site;

- request the owner/occupant to contact the local Ministry of the Environment office to discuss the possibility that coal gasification - related wastes may be present on their site, and the associated environmental concerns;
- review in detail the site history, waste storage locations, site excavation history, utility locations, geotechnical information, and past environmental problems to co-ordinate overall site assessment;
- soil gas sampling to assess locations of buried wastes and extent of contaminant migration;
- geophysical surveys (e.g., ground probing impulse radar or electromagnetic induction) to determine locations of buried waste storage facilities;
- investigations of utility lines especially storm and sanitary sewers for evidence at gas plant wastes;
- soil sampling and visual inspection of samples in selective areas of the site to identify the extent of on-site and possibly off-site contamination;
- excavation and removal of buried waste storage facilities using environmentally secure methods.

4.3.37 Toronto - Station B

Site Description

The Toronto Station B gas works was a very large (14 ha) gas facility located on Eastern Avenue and now bounded primarily by Lakeshore Drive, Eastern and Booth Avenues and the Canadian National Railway tracks. The plant was operated by Consumers Gas Company from about 1909 to 1954 producing gas by both the coal carbonization and the carburetted water gas process.

The gas plant property is presently occupied, because of its size, by several different parties. The majority of the former gas plant is occupied by various departments (Parks and Recreation, Public Works, City Property, and Buildings and Inspection) of the Corporation of the City of Toronto. The City of Toronto property fronts onto Eastern and Booth Avenue and is used for office, parking, garage and storage space. Their property is completely fenced with gates at the entrances as well as containing a large area of fenced storage compounds. The Consumers Gas Company has retained the northwest portion of the former gas plant site and uses the site for an office, garage, parking and general storage. Their property is fenced with access controlled by gates. The southwest portion of the former gas plant is occupied by Lever Brothers Limited and is primarily used for truck parking associated with their factory to the west. Their property is also fenced with controlled access. The southeast portion of the property is occupied by a laundry factory and it too has controlled access. A small area, between Consumers Gas and the City of Toronto, is occupied by a bakery and a photographic studio.

Adjacent property consists of residential land use to the north, industrial land use to the west and south and industrial/commercial land use to the east. The former gas plant site is approximately 200 m from the Don River on the west and Ashbridges Bay

on Lake Ontario to the south. Numerous utility lines including storm and sanitary sewers, water mains, gas mains, telephone cables and abandoned ammonia pipelines are found on Eastern and Booth Avenues.

Potential Environmental Impact

The Station B gas works was a very large facility in operation for about 50 years and therefore the volume of waste material generated would also be large. However, most of ammonia liquor and tar was sold as a by-product and did not remain on-site. The coal tar and ammonia was removed via pipeline (to Station A) or train tanker by the contractor. Any wastes that remained on-site after demolition would most likely be that volume that remained in storage facilities (i.e., tar tanks and wells) and process equipment (i.e., gas holding tanks, pipelines, etc.). Information collected to date indicates that waste materials are present on-site even though the site inspection failed to identify on-site problems.

In 1976, the City of Toronto property was developed to construct the existing Works Yard and during the construction large volumes of waste materials were encountered in several locations. In 1977, it was reported that between 340 and 450 m³ of an oil-tar substance were discovered in a 23 metre deep tank. The present information suggests that this material was removed by the city but the extent of removal (i.e., volume removed, date of removal, tank excavation) can not be confirmed nor can the location of waste disposal be identified. In 1979, a liquid bituminous waste was discovered in a large sump located near the western boundary of the Work Yard. This sump contained at least 34 m³ of waste material. Again there is evidence to indicate the waste was removed but the details of removal are not known at this time. A soils inspection report completed to investigate footings of new buildings for the Works Yard identified oil stains in a grey sand at a depth of 2.6 metres below surface.

Historical maps and air photos for the site also indicate at least seven underground tar or ammonia liquor tanks were located on-site.

From this information, it is apparent that waste material has been identified on-site and it is possible that more waste contained in buried tanks may still exist on the property. There is a potential for some environmental impact at this site as buried waste has been found on the site in the past. This potential reflects the present land use and accessibility of the property. The property is mostly industrial/commercial land use and at present the majority of the former waste storage areas are undeveloped and used for storage or parking. The former waste storage areas are also largely inaccessible to the general public due to fencing and locked gates. Given that the most significant receptors for impact are the occupants of the residences to the north and the property workers it is unlikely that they will come into contact with the waste material. Similarly the surface water bodies are at sufficient distances such that they are unlikely to receive waste material by normal seepage. The only possible impacts for this site may result from seepage of contaminated material to utility lines or building sumps or odours resulting from volatilization of buried wastes. If the property were to be developed, the potential environmental impacts would rise significantly.

Options for Further Action

For the Toronto-Station B site, the following are considered appropriate options for further actions:

- notify property owners and municipality that buried gas plants wastes may be found on-site;

- request the owners/occupants to contact the local Ministry of the Environment office to discuss the possibility that coal gasification - related waste may be present on their site, and the associated environmental concerns;
- inspection of utility lines especially storm and sanitary sewers, and building sumps for evidence of coal tar wastes;
- if as a result of the above inspections, gas plant wastes are found to be entering underground utility lines and sewers then on-site investigations are required to identify the source and nature of the wastes.

4.3.38 Toronto - Station C

Site Description

The Toronto Station C facility was a gas storage area (2.4 ha) consisting of two large gas holding tanks and gas was not produced on the property. Consumers Gas Company owned and operated the facility from about 1909 until 1954 on property located at the northwest corner of Bathurst Street and the Canadian National Railway tracks. The property is bounded by Bathurst, Niagara and Tecumaeht Streets and the CN tracks.

Today, the property is occupied by the Toronto Refiners and Smelters Ltd. and the area of the gas holding tanks is presently a parking lot and storage area for used car batteries and a metal smelter. Adjacent land use consists of residential land use to the north, industrial/commercial to the west and east and the CN Railway to the south. The nearest surface water body is Lake Ontario located 300 metres to the south

Potential Environmental Impact

This site did not produce gas and therefore buried wastes may only be associated with tar residue remaining on the foundation of the former gas holding tanks. There have been no reports of buried wastes on-site at this location. The property is now an industrial area with access controlled by fences and locked gates. No development is planned for this property.

The potential for environmental impacts from this site is considered to be low as a result of no gas production on-site, industrial land use with controlled access and no reported wastes on-site.

Option for Further Action

For the Toronto-Station C site, the following are considered appropriate options for further actions:

- no further actions are required at this site other than notifying the present owners and municipality that buried gas plant wastes may be found on-site.

4.3.39 Waterloo

Site Description

The Waterloo gas works was located east of Regina Street (formerly Queen Street South) on a triangular tract of land bounded by Regina, William and Herbert Street. Herbert Street has recently been abandoned between Regina and William Street. The chain of ownership of the site is uncertain but the gas facilities were operated initially by the Waterloo Gas Company starting in 1889 to about 1894 and then operated by the Waterloo Consumer Gas Company from 1894. Historical records also indicate other operators, such as the Waterloo Gas Department (1914-1920) (part of the PUC?) and the Waterloo Public Utilities Commission (1947-1957). The total operating period was from 1889 to about 1942 but the gas holding tank was used as a gas reservoir with coal gas supplied from Kitchener until about 1957. Gas was produced initially by coal carbonization using retorts but was converted to water gas early in its history.

Today, the gas plant property is under development with on-going construction of the Waterloo City Centre and commercial office space. The construction includes underground parking and the diversion and rerouting of Laurel Creek which transverse the north end of the property. Adjacent land use consists of CN Railway and commercial property to the north, commercial land use to the west and residential land use to the south and east. The William Street Pumping Station, a municipal water supply facility is also located immediately to the south of the property.

Potential Environmental Impact

In June 1986, construction of foundations for the Waterloo City Centre encountered coal tar from the former gas plant. Consequently, several studies have been implemented to determine the

extent of coal tar contamination, to provide remedial measures for the clean-up of the site, and to assess the nature and magnitude of the potential environmental impacts. The studies have been funded by local property owners and the work has been completed by their consultants. To date, the on-going investigations have been extensive and comprehensive but it is beyond the scope of this report to provide all the details of these studies. The following paragraphs are a brief overview of the problem.

The initial excavation for foundation construction encountered two buried tanks containing a black oily substance later confirmed to be coal tar. The liquid volume was estimated to about 72 m³. In addition, a large volume of contaminated soil was associated with the buried tanks and fill material around the tanks. Because the tanks and contaminated soil was adjacent to Laurel Creek and near to municipal water wells detailed soils investigations and groundwater monitoring were implemented in the area of the buried tanks and the pumping wells to assess the potential environmental impact. The municipal wells were shut down as a precautionary measure. Initial water quality samples from the municipal wells detected trace levels of carcinogenic PAH but subsequent samples failed to confirm this result.

Soil and groundwater sampling identified a zone of coal tar contamination in a sand and gravel seam adjacent to the buried tanks and Laurel Creek and extending out under Regina Street in the area of Herbert Street. Sediments from Laurel Creek were collected and the resulting analyses indicated PAH were present in relatively high levels. The occurrence of tar in Laurel Creek was originally reported in the May 1, 1925 issue of the Intercolonial Gas Journal (p. 171).

Studies to date indicate that a significant environmental impact is presently occurring as indicated by groundwater contamination and surface water pollution. These impacts, however, are being addressed by on-going studies and it is, therefore, difficult to assess

the future impact of this site. It is assumed that with MOE guidance the future potential for environmental impacts will be greatly reduced.

Options for Further Action

Consultants hired by the property owner and the municipality are presently conducting additional studies at the Waterloo site. Pending completion and documentation of these studies, the only action required is notification of the adjacent property owners and municipality that buried waste may be found on-site and may be migrating off-site.

The Ontario Ministry of the Environment is continuing to monitor this site in order to ensure compliance with environmental regulations.

4.3.40 WindsorSite Description

The Windsor Gas Co. operated a medium-sized retort coal gasification plant from 1871 to 1930, or for about 59 years, on the south side of McDougall St. opposite the southwesterly extension of old Brant St. Brant St. now terminates at Glengarry Ave. The site is presently occupied by a City of Windsor parking lot and is located in a residential/public use area. Land use on adjoining properties includes residences, parking lot, arena, restaurant, high rise apartment building, police garage and a hydro substation.

The site is about 300 m south of the Detroit River which has recreational and industrial use in the vicinity of the site. The drinking water supply for the City of Windsor is derived from the Detroit River at a location about 4 km upstream from the site.

Potential Environmental Impact

No immediate environmental impacts or adverse health effects are perceived for this site. However, historical accounts from a Windsor resident indicate that gas plant wastes are likely buried at the site. The same resident also indicated that some waste was removed from site to an unknown location. The buried wastes were estimated to be about 50 m from the north fence and 12 m from the parking lot curb (on McDougall Ave.). During on-site inspections, the only evidence of buried waste was a faint intermittent odour of tar from the storm manhole located in the general area of the assumed buried waste identified above. From historical maps this is the general location of the gas plant condensers, an area where tar was removed from manufactured gas prior to purifying and storage. Together these accounts suggest that waste is buried at this site. However, because of the distance to surface water, the lack of groundwater use and the

lack of excavation into and development on the property, no immediate impacts are thought to exist at this site. However, excavation at the site could result in exposure of gas plant wastes and an environmental impact and adverse health effects.

Options for Further Action

For the Windsor site, the following are considered appropriate options for further actions:

- notify present owner and municipality that buried gas plant wastes may be found on-site.
- no further actions are required at this site unless the site is developed at which time soil sampling to identify buried wastes is required.

4.3.41 Woodstock

Site Description

The Woodstock Gas Light Co. operated a small (0.4 hectare) coal gasification plant on the east side of Young Street, south of Peel Street from about 1876 to sometime before 1919 or about 43 years. The former gas plant property is now occupied by a parking lot and building of an automotive company, a gas metering station of Union Gas Company and a private vacant lot planned for townhouse development. The original gas manufacturing plant and gas holder was located on the automotive property. In 1897, the Woodstock Gas Light Co., acquired the property now owned by Union Gas and the property planned for townhouse development, and erected a larger gasometer on the property planned for townhouse development. Although the plant ceased operation sometime prior to 1913, the gasometer remained in place until at least 1928. The gas plant site served as an automobile junk yard from about 1919 to at least 1949.

The site is now located in a mixed residential commercial area with adjoining land uses that include parking lot, lumber yard, railway line, townhouses and residences. The closest surface water is now Cedar Creek located about 750 m southwest of the site. Two small surface ponds once existed immediately south of the gas plant as evident on the 1876 and 1919 maps. In addition to the planned townhouse development, the City of Woodstock plans to extend Main and Young Streets in the area of the former gas plant.

Potential Environmental Impact

Late in 1986, coal tar was observed seeping into an excavation, on the east side of Young Street in the vicinity of the Union Gas property. Subsequent to this discovery a consultant was retained by the City of Woodstock and the townhouse developer, to

assess the site. During inspections of the site, concrete rubble with tarry stains and residue were observed and strong tar odours were noticed emanating from a sanitary sewer manhole. Also several of the wells installed by the consultant had tar odours indicating the presence of buried gas plant wastes. A large open pipe (0.35 m diameter) that extended 3 m into the ground was also observed to have strong odours of tar. All of these observations of tar are in the vicinity of the former gasometer which was located south of the main gas works facilities.

Given the planned road extensions, townhouse development and evidence of buried waste, there is a strong potential for exposure of wastes and environmental impact at this site. Some adverse health effect may also be possible if excavation proceeds without consideration of the extent and potentially harmful effects of these wastes on the workers.

Some seasonal demand for drinking water is provided by two wells located 600 m north of the site at Ingersoll Avenue and Huron Street and 900 m south at the end of Victoria Street. These wells are infrequently used and not thought to be within the area impacted by the gas works wastes.

Options for Further Study

For the Woodstock site the following are considered appropriate options for further actions:

- sampling at the nearest water supply wells (Ingersoll Avenue and Huron Street and Victoria Street wells) and analysis for general water quality and PAH compounds.

Consultants have been hired by the property owners and studies are on-going at this site. Pending completion and documentation of these studies, the only additional action required is notification of property owners and municipality that buried wastes were found on-site and may be migrating off-site.

5. OTHER SITES POSSIBLY RELATED TO COAL TAR WASTES

In addition to the "town gas" facilities identified in Section 4 of this report, other facilities that used coal and oil carbonization and that generated and handled typical gas plant wastes, such as PAH-rich tars and sludges are listed below. This listing is not complete as these other sites were not specifically researched but were identified coincidentally in the course of searching historical records for "town gas" plants as part of Phase 1 of this project.

5.1 GAS PLANTS ASSOCIATED WITH BY-PRODUCT PLANTS OF THE STEEL INDUSTRY

The manufacture of steel requires the generation of coke. By-product coke ovens or plants, such as those of Algoma Steel Corporation, Steel Company of Canada and Dominion Foundries and Steel Co. carbonize coal and generate by-products of ammonia, gas and tar. The by-products produced are usually sold or used on-site for fuel.

Algoma Steel Site, Sault Ste. Marie

The Algoma Steel Corporation facility operated in Sault Ste. Marie and provided gas to the Great Northern Gas Co. The site remains on Algoma property at the south end of Goulais Avenue.

Steel Company of Canada Site, Hamilton

The Steel Company of Canada property located on Hamilton harbour, north of Burlington Street East in the area of Wilcox and Birmingham Streets used coke ovens and by-products plants in the manufacture of steel. The site continues as part of Stelco's Hamilton operations.

The Dominion Foundries and Steel Co. Ltd. Site, Hamilton

The Dominion Foundries and Steel Co. Ltd. operated a battery of coke ovens at their property on Burlington Street East between Kenilworth and Depew Streets. In particular, a by-product plant operated on the property adjacent to Hamilton harbour and included a coke oven gas holder, tar tanks, gas oxide boxes and a light oil plant. The property continues to operate as part of Dofasco's Hamilton operations.

5.2 GAS PLANTS ASSOCIATED WITH AMMONIA/FERTILIZER MANUFACTURING

Because coal is rich in nitrogen, carbonization of coal releases significant amounts of nitrogen in the form of ammonia which is readily oxidized to nitrite and nitrate. Treatment of ammonia with sulphuric acid results in the precipitation of ammonium sulphate, a valuable raw material for fertilizer production.

American Cyanamid Co. Site, Niagara Falls

A coal gasification plant was identified as part of the fertilizer plant of American Cyanamid, Niagara Falls, Ontario. The plant was identified on a 1916 fire insurance plan (Public Archives Canada, NMC 9582, Sheet 22) with a gas house, gas holder and tar well. The plant likely provided gas for lighting and heating as well as raw materials for the manufacture of fertilizers. The site is still part of Cyanamid Canada's plant located off Stone Road at the north end of Fourth Avenue.

5.3 MANUFACTURED GAS PLANTS FOR INDUSTRIAL LIGHT AND HEAT

Large industrial operations were often of sufficient size to warrant the operation of a manufactured gas plant to provide lighting and heating requirements.

Ford Motor Co. Site, Walkerville (Windsor)

The Ford Motor Co. of Canada operated a coke oven gas plant with gas cleaning equipment and 14,200 m³ capacity gas holding tank in the early 1900s. A 1924 fire insurance plan (Regional Collection, University of Western Ontario, Sheet 13) identifies the gas plant. The facility was part of the company power plant and likely provided gas for heating and lighting. The site was located in East Windsor on Ford Motor Company property, east of Belle Isle View Avenue and south of Riverside Avenue. The Ford Motor Company of Canada established their power plant on this site in 1934 and this site continues to have this use. The site is about 200 m south of the Detroit River.

Preston Woolen Mill, Preston

Possibly from 1870 to an uncertain date after 1884, Preston Woolen Mills, located on Eagle Street near Hedley, utilized a coal gasification plant to provide light. A separate gas house and gas holding tank is evident in an 1884 fire insurance plan (Public Archives Canada, NMC 9641). The property is now occupied by a company engaged in the manufacture of plastics from powders and resins.

5.4 WOOD PRESERVATIVE PLANTS

Creosote and tars produced from the carbonization of coal were often utilized as wood preservatives. The tars may have been provided from a nearby gas plant or coke oven or manufactured on-site in a small retort house.

Canada Creosoting Co. Ltd., Sudbury

A fire insurance plan (1942 Sheet A & 7) from the Ontario Archives identified the Canada Creosoting Co. plant as being located on the south side of Lorne Street, between Dean Avenue and Bulmer Avenue. The facility is characterized by a retort house, boiler house and several creosote and tar tanks. Current land use for this site is commercial/residential.

5.5 PINTSCH GAS PLANTS

Pintsch gas plants were manufactured gas facilities that produced gas from pyrolysis of petroleum oils.

North Bay, Thunder Bay

Dominion Bureau of Statistics reports identified Pintsch gas plants in North Bay and Thunder Bay (Fort William) for the approximate period 1919-1939. These facilities were likely small and appear to have produced gas for lighting in railway coaches. The Pintsch gas plants for North Bay and Thunder Bay were briefly researched through map sources but not specifically located.

Toronto

A small Pintsch gas plant was identified in Toronto on the grounds of the old Grand Trunk Railway at the bottom of Spadina Avenue south of Front Street West on the Toronto harbour. The plant is evident on a 1908 fire insurance plan (Public Archives Canada, NMC 31775, Sheet 75) and was adjacent to the old Toronto Water Works. The plant is identified as Pintsch Compressing Co.'s Gas Plant and has a gas house, purifying room, gas holder and underground oil and tar tanks. The period of operation of this plant is uncertain, but the plant likely ceased operation prior to 1912.

5.6 MANUFACTURED GAS PLANTS FOR METAL REFINING

Blue water gas may be used in the reduction and refining of metals, such as nickel.

Inco Ltd. Refinery, Port Colbourne

A small blue water gas unit was operated by Inco. Ltd. as part of the Port Colborne nickel refinery from 1931 to 1969. Gas was produced by passing steam through heated coke. The gas was consumed in the refining process and by-products, such as tar were burned on-site. The former location of these facilities has been paved over and is now used as a controlled-access, Inco storage yard.

5.7 TAR DISTILLATION INDUSTRIES

Most tar produced from coal gasification after about 1890 to 1900 had potential reuse as a raw material for the tar distillation industry. Similarly, water gas tars had potential resale value as raw materials to a secondary processing industry, such as a varnish company. Because tar was supplied from manufactured gas plants the location of such facilities is expected to be related in part to the location of former gas plants.

Currie Products Ltd. Site, Ottawa

A small tar distillation facility operated south of Lees Avenue opposite the Lees Avenue manufactured gas plant. The plant operated from about 1920 to sometime in the late 1940s. A small batch still refined crude coal tar to lighter fraction oils and pitch. The property of the former distillation plant is now occupied with a high-rise apartment building. Tar contamination has been identified beside and below this building from studies commissioned by the Ontario Ministry of the Environment.

Paterson Manufacturing Ltd. Site, Toronto

From the 1890's to 1918, Paterson Manufacturing Ltd. operated a tar distillation facility south of the Toronto A site on the Toronto harbour. The facility continued operation under the name Barrett Co. Ltd. from 1919 to at least 1924. A batch still with numerous surface storage tanks and a tarring machine building characterize the site. Present land use includes a school, community centre and highrise apartment building. Contamination problems for this site are unknown.

REFERENCES

- Arcos, J. and M.F. Angus, 1974. Chemical Induction of Cancer. Bal. 11A, Academic Press, New York.
- Dipple, A., 1976. Polynuclear aromatic carcinogens. In: Chemical Carcinogens (ACS Monograph No. 173) C.E. Searle, ed., Washington, D.C., American Chemical Society, pp. 245-314.
- Environmental Research and Technologies Inc. (ERT) and Koppers Company Inc., 1984. Handbook on Manufactured Gas Plant Sites. Prepared for Utility Solid Waste Activities Group, Superfund Committee, Washington, D.C.
- Environmental Resources and Technology Inc. (ERT), 1983. Recommended Plan for a Comprehensive Solution of the Polynuclear Aromatic Hydrocarbon Contamination Problem in the St. Louis Park Area, Appendix I. Environmental Research and Technology Inc., Concord, MA, Document P-B690-161.
- Morgan, J.J. 1945. Water Gas. In Lowry, H.H. 1945. Chemistry of Coal Utilization. John Wiley and Sons.
- Occupational Health Program McMaster University, 1986. Health Effects of Coal Tar Products and Bitumens. Submitted to Ontario Ministry of Labour Special Studies and Services Branch.
- Shear, M.J., 1938. Studies in Carcinogenesis. V. Methyl Derivatives of 1,2 Benzanthracene. Am. J. Cancer, Vol. 33, pp. 499-537.
- Shear, M.J., 1941. Studies in Carcinogenesis. XVI. Production of Subcutaneous Tumors in Mice by Miscellaneous Polycyclic Compounds. J. Natl. Cancer Inst., Vol. 2, pp. 241-258.
- Santodonato, J., P. Howard and D. Basu, 1981. Health and Ecological Assessment of Polynuclear Aromatic Hydrocarbons. J. Environ. Pathol. Toxicol. (Special Issue), 5(1), pp. 1-366.
- U.S. EPA, 1980a. Ambient Water Quality Criteria for Benzene, U.S. EPA Report 440/5-80-18, Washington, D.C.
- U.S. EPA, 1980b. The Carcinogen Assessment Group's List of Carcinogens. Washington, DC.

